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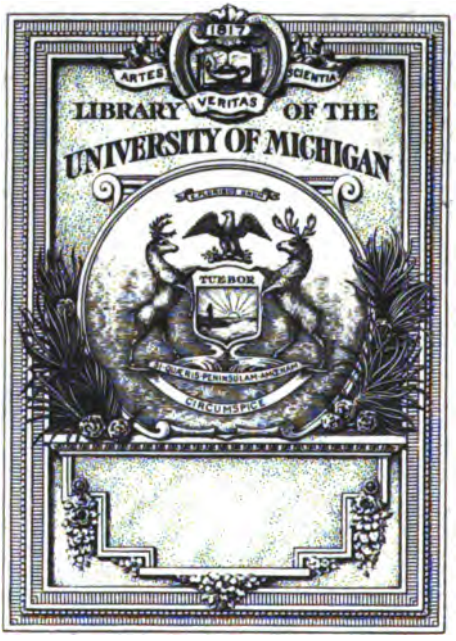

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TRANSACTIONS OF THE

American Medical association.

SECTION ON

Genito-Urinary Diseases

of the
American Medical Association
at the Sixty-Eighth Annual
Session, held at New York
City, June 5 to 8, 1917

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LIST OF OFFICERS

The officers named below have served this Section.

1910 Chairman, W. T. Belfield, Chicago.
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1911 No meeting.

1912. Chairman, Hugh H. Young, Baltimore.
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Secretary, W. F. Braasch, Rochester, Minn.
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PROCEEDINGS OF THE SECTION

Wednesday, June 6—Morning

The meeting was called to order by the vice chairman, Dr. Carl L. Wheeler, Lexington, Ky., at 9:30.

Drs. Frederick W. Robbins and Frank C. Seabury, Detroit, presented a paper on the "Treatment of Chancroids." Discussed by Drs. Noah E. Aronstam, Detroit; Herman L. Kretschmer, Chicago; Charles W. Bethune, Buffalo; B. S. Barringer, New York; J. L. Boogher, St. Louis; G. G. Smith, Boston; Irwin E. Colgin, Waco, Texas, and Frederick W. Robbins, Detroit.

Dr. Anton G. Rytina, Baltimore, read a paper on "Clinical Consideration of Verumontanum Diseases Based on Histopathology." Discussed by Drs. C. M. Harpster, Toledo; J. B. Cross, Buffalo; O. S. Lowsley, New York; Leo Buerger, New York; Theodore Baker, Pittsburgh; R. H. Herbst, Chicago, and Anton G. Rytina, Baltimore.

Dr. Eugene Fuller, New York, read a paper on "External Urethrotomy and Seminal Vesiculotomy Combined in a Single Operative Procedure." Discussed by Drs. E. O. Smith, Cincinnati; R. H. Gibbons, New York, and Engene Fuller, New York.

Dr. Edward G. Ballenger, Atlanta, Ga., showed moving pictures of various genito-urinary operations and procedures.

Wednesday, June 6—Afternoon

Dr. George G. Smith, Boston, read a paper on "Bladder Disturbances Due to Nerve Lesions." Discussed by Drs. W. C. Quinby, Boston; Bransford Lewis, St. Louis; John T. Geraghty, Baltimore; C. M. Harpster, Toledo, Ohio; Leo Buerger, New York; Martin Krotoszyner, San Francisco; W. F. Braasch, Rochester, Minn.; Edward L. Keyes, Jr., New York; Charles W. Bethune, Buffalo; Winfield Ayres, New York, and George G. Smith, Boston.

Dr. Bransford Lewis, St. Louis, read a paper on "Vesical Diverticula: Operation in Two Cases, with Remarks on Technic."

Dr. John T. Geraghty, Baltimore, read a paper on "A Study of the Results of Treatment of Various Types of Bladder Tumors."

Dr. Benjamin S. Barringer, New York, read a paper on "Radium Treatment of Bladder and Prostatic Carcinoma."

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These three papers were discussed by Drs. Edward L. Keyes, Jr., New York; W. F. Braasch, Rochester, Minn.; G. G. Smith, Boston; Leo Buerger, New York; Martin Krotoszyner, San Francisco; W. C. Quinby, Boston; Bransford Lewis, St. Louis; John T. Geraghty, Baltimore, and B. S. Barringer, New York.

Thursday, June 7—Morning

The secretary read the resolution adopted by the House of Delegates in regard to the number of units for each section. He said he did not think, from his experience while secretary, that three units, with a maximum of eighteen papers, would be sufficient, and he felt that there should be at least four units.

Dr. H. A. Fowler, Washington, D. C., offered the following resolution:

Believing that the action recently taken by the House of Delegates whereby the number of units of the program of the Section on Genito-Urinary Diseases has been reduced to three is insufficient for the needs of the section, the members of the section emphatically protest against such action, and request that the minimum number of units be not less than four.

The resolution was adopted.

The following nominating committee was appointed: Dr. Herman L. Kretschmer, Chicago, chairman; Dr. G. G. Smith, Boston, and Dr. H. G. Bugbee, New York.

Dr. Harry A. Fowler, Washington, D. C., read a paper on "Syphilis of the Bladder." Discussed by Drs. Martin Krotoszyner, San Francisco; G. G. Smith, Boston; Charles J. Watterston, Birmingham, Ala., and Harry A. Fowler, Washington, D. C.

The following papers were read as a symposium on "Roentgenographic and Clinical Diagnosis of Lithiasis in the Urinary Tract":

Dr. Eugene W. Caldwell, New York: "Review of a Series of Roentgenographic Examinations of the Urinary Tract."

Dr. Leon T. Lewald, New York: "The Differential Diagnosis of Lesions of the Urinary Tract from Those of the Gastro-Intestinal Tract, with Special Reference to Concretions in the Appendix."

Dr. Edward L. Young, Jr., Boston: "The Clinical Diagnosis of Lithiasis of the Urinary Tract."

Dr. Henry G. Bugbee, New York: "Clinical Study of Lithiasis Based on a Series of One Hundred and Ninety-Eight Cases."

These four papers were discussed by Drs. Henry K. Pancoast, Philadelphia; W. F. Braasch, Rochester, Minn.; H. L. Kretschmer, Chicago; Abraham Hyman, New York; James W. Hunter, Norfolk, Va.; H. A. Fowler, Washington, D. C.;

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G. G. Smith, Boston; A. M. Wose, Syracuse, N. Y.; V. D. Lespinasse, Chicago; B. S. Barringer, New York; J. E. Burns, Baltimore; A. J. Crowell, Charlotte, N. C.; C. M. Harpster, Toledo, and Edward L. Young, Boston.

The following officers were elected: chairman, Dr. Edward L. Keyes, Jr., New York; vice chairman, Dr. Martin Krotoszyner, San Francisco; secretary, Dr. W. F. Braasch, Rochester, Minn.; delegate, Dr. E. O. Smith, Cincinnati; alternate, Dr. Oliver Lyons, Denver.

Thursday, June 7—Afternoon

Dr. Martin Krotoszyner, San Francisco, read a paper on "The Intravenous Phlorizin Test."

Drs. Benjamin A. Thomas and Joseph C. Birdsall, Philadelphia, presented a paper on "Comparative Results of a Number of Functional Kidney Tests on a Series of Patients."

These two papers were discussed by Drs. Robert H. Greene, New York; B. S. Barringer, New York; Abraham Hyman, New York; W. F. Braasch, Rochester, Minn.; A. G. Rytina, Baltimore; H. L. Kretschmer, Chicago; George W. Stark, Syracuse, N. Y.; John T. Geraghty, Baltimore, Martin Krotoszyner, San Francisco, and Benjamin A. Thomas, Philadelphia.

Dr. Herman L. Kretschmer, Chicago, read a paper on "The Value of Making a Routine Leukocyte Count on the Urine in Infections of the Higher Urinary Tract." Discussed by Drs. Martin Krotoszyner, San Francisco; W. C. Quinby, Boston, and George A. Wyeth, New York.

Dr. Abraham Hyman, New York, read a paper on "Surgical Diseases of the Urinary Tract in Children." Discussed by Drs. Leo Buerger, New York; H. L. Kretschmer, Chicago; Martin Krotoszyner, San Francisco; C. G. Bandler, New York, and Abraham Hyman, New York.

Dr. Charles E. Barnett, Fort Wayne, Ind., read a paper on "Polycystic Kidney." Discussed by Drs. Robert C. Bryan, Richmond, Va.; A. J. Crowell, Charlotte, N. C.; A. G. Rytina, Baltimore; B. A. Thomas, Philadelphia; O. S. Lowsley, New York; Martin Krotoszyner, San Francisco; John H. Cunningham, Jr., Boston; Herman L. Kretschmer, Chicago, and Charles E. Barnett, Fort Wayne, Ind.

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TREATMENT OF CHANCROID

FREDERICK W. ROBBINS, M.D.
Fellow of the American College of Surgeons
AND
FRANK P. SEABURY, M.D.
DETROIT

We recognize four clinical varieties of chancroid:

1. Ulcus molle, the ordinary variety of ulcer, has the characteristic punched-out appearance, with edges cleancut and often undermined.

2. Ulcus molle miliare begins as a small papule, which rapidly becomes a pustule, the center of which is a deep craterlike ulcer. It occurs most frequently on exposed surfaces in the loose skin, just posterior to the mucocutaneous junction of the prepuce in man and about the labia majora and the perineum in woman.

3. Ulcus molle elevatum is the sore most frequently confused with indurated chancre. Its incubation period is from nine to twenty-one days. The sore is slightly raised above a mildly infiltrated base. The edges are not undermined, and it has little tendency to spread. This form is resistant to ordinary treatment and is prone to persist for from four to eight weeks.

4. Ulcus molle phagedenicum is the most severe and the most resistant form with which we are familiar, and occurs as a complication of both chancroid and syphilis. It spreads rapidly, is made worse by any half-way measures, and, unless checked early, is capable of destroying a part or even the whole of the penis.

To these McDonagh adds a fifth classification, the ulcus molle serpiginosum. This ulcer may occur as

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a complication of bubo or it may begin as a furuncle in the groin. It is found chiefly in the tropics, is highly resistant to all forms of treatment, and frequently remains a slowly spreading ulcer for years. We have never encountered it in this country.

The treatment of chancroid, at the best, is unsatisfactory, as is evidenced by the great variety in the methods of treatment advocated by different authors. If seen early, a fair percentage of patients do well under nearly any antiseptic treatment, particularly if they are cleanly in their habits. In fact, we believe that 60 per cent. of chancroids, taken as they come, of anywhere from two days to two months' duration, will heal in from four to eight weeks with no treatment except rigid cleanliness, a little calomel, or other dusting powder, if the sore is within the preputial cavity, or a moist dressing of black wash if the sore is exposed. If seen within the first two or three days, thorough cauterization with nitric acid is quite successful, but great care must be used not only to destroy completely every sore, but to keep the surrounding tissue covered with an antiseptic until healing of the cauterized areas is complete.

It is the sores that are not seen early, or that are not favorably influenced by cauterization, which cause the trouble and for which we have never been able to find in the literature a thoroughly satisfactory method of treatment.

Zinc ionization gives good results, but requires special apparatus and consumes considerable time. Argyrol crystals applied directly to the sore for three or four minutes, followed by a moist dressing of 10 per cent. argyrol or 1 per cent. protargol, have been satisfactory in a few cases; in others they have not even checked the spreading of the ulcer.

A satisfactory method of treatment for the large majority of cases of chancroid in the preputial cavity is the thorough application of a 25 per cent. solution of copper sulphate crystals in water. The ulcer is

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first anesthetized with a 10 per cent. cocain solution and then lightly curetted with an applicator wound firmly with cotton, after which the copper solution is applied. It is left in contact with the sore for three or four minutes and then sponged off. On the dry sore a light dusting powder, calomel or a morphin-narcotin mixture is used, and one or two thicknesses of gauze, moistened with black wash or tap water, are applied and the foreskin drawn forward over the whole. This is changed two or three times daily; and every second day, unless granulation is progressing satisfactorily, a 10 per cent. solution of copper sulphate is applied. The majority of chancroid ulcers do well under this treatment, but from 15 to 20 per cent. tend either to persist many weeks, or to grow gradually larger and deeper in spite of treatment. The direct cause is the failure to sterilize the wound.

In order that a method of treatment of chancroids may be regarded as satisfactory, it must not only effect a complete sterilization of the sore and thereby a cure of practically all cases within a reasonable length of time, but in order to be available to the large majority of physicians, it must also be comparatively simple in form and means of application. Such a method, or combination of methods, we believe we have devised, and we base our conclusions on the observation of about sixty cases during the past year. In this series we have had practically 100 per cent. of early cures.

Regardless of the appearance, duration or previous treatment of a venereal sore before it is destroyed, it is always examined for spirochetes.

If antiseptics have been used, it is our custom to apply a moist dressing of cotton wet with tap water for from twenty-four to seventy-two hours, during which time two or three microscopic examinations are made. If no treatment has been previously given, the examination and destruction of the sore is accomplished at the first visit.

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RESULTS OF AUTHORS' METHOD OF

Case No.	No. of Lesions	Incubation Period	Previous Treatment	Duration Before Fulguration	Darkfield or Stain	Diagnosis*
1	1	7 days	No	2 weeks	Negative	U. M.
2	2	13 days	Argyrol dusting powder	2 months	Negative	U. M. M.
3	1	7-8 days	Argyrol crys.	4 weeks	Not made	U. M.
4	3	7 days	No	1 day	Negative	N. M.
5	2	4 days	Caustic argyrol and violet ray	6 weeks	Negative	U. M. M.
6	1	4-5 days	Caustic aristol argyrol	5 weeks	Negative	U. M.
7	1	Indefinite	None	3 weeks	Negative	Chancre
8	4	4 days	Antiseptic wash	3 weeks	Not made	U. M.
9	1	10-12 days	None	12 days	Negative	U. M. E.
10	1	Indefinite	None	4 days	Negative	U. M.
11	2	Indefinite	None	17 days	Negative	U. M. M.
12	1	Indefinite	Salve	7 days	Negative	Chancre
13	2	2 weeks	Caustic and calomel	2 weeks	Negative	U. M. E.
14	1	Indefinite	None	3 days	Negative	U. M.
15	1	10 days	Dusting pow.	7 days	Refused	U. M. E.
16	1	Indefinite	None	8 days	Negative	U. M. M.
17	3	9 days	None	1 day	Negative	U. M.
18	1	Indefinite	None	10 days	Negative	U. M.
19	1	4-5 days	None	7 days	Negative	U. M. M.
20	4	9-10 days	Calomel	3 weeks	Not made	U. M. E.
21	3	2-3 days	Antiseptic	6 weeks	Refused	U. M. P.
22	1	12-13	Antiseptic	8 days	Negative	U. M. M.
23	2	Indefinite	None	2 weeks	Negative	U. M.
24	1	Indefinite	?	2 months	No	U. M.
25	2	Indefinite	None	10 days	Negative	U. M.
26	3	2 weeks	Ointment	4 weeks	None	U. M.
27	2	5 days	None	3-4 days	None	U. M.
28	1	2 weeks	?	5 days	Negative	U. M. M.
29	1	10 days	None	2 days	Negative	?
30	3	4 days	Calomel	14 days	Negative	U. M. E.
31	1	5 days	None	3 days	Negative	U. M.
32	2	Indefinite	None	11 days	Negative	U. M.
33	5	Indefinite	Calomel	8 days	Negative	U. M.
34	1	Indefinite	Aristol	2 weeks	Negative	?

* Names in diagnosis column: U. M., Ulcus molle; U. M .M., Ulcus molle miliare; U. M. E., Ulcus molle elevatum; U. M. P., Ulcus molle phagedenicum.

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TREATMENT IN THIRTY-FOUR CASES

Number of Treatments with Violet Ray	Healed	Bubo	Wassermann	Remarks
One	8 days	No	None	
One	9 days	Yes, not opened	Negative	Bubo subsided
One	7 days	No	None	
One	11 days	No	Negative	2 or 3 sores healed in 4 days
One	7 days	No	None	Exposed sore
One	9 days	No	None	Exposed sore
One	5 days	No	None	Hard chancre developed at site of sore
One	5 days	No	None	
One	5 days	No	None	
One	4 days	No	None	
Three	16 days	Yes, not opened	Negative	
Two	14 days, not healed	No	Positive	
One	6 days	No	None	Circumcised 2 days after healing; ½ circumference became chancroidal, healed in 2 weeks
One	5 days	No	None	
One	6 days	No	Refused	
One	7 days	No	None	
One	6 days	No	+++	Hard chancre developed at site of sore
One	5 days	No	None	
Two	14 days	Yes	None	Bubo incised, healed slowly; applied $CuSO_4$ and violet ray, healed rapidly
Two	9 days	Yes, subsided	Refused	
Three	25 days	No	Refused	Phagoclinic case; patient very uncleanly
One	5 days	No	None	
One	10 days nearly	Yes	None	
Two	5 days nearly	Yes, incised	Negative	Nearly healed on 5th day; not seen afterward
One	10 days	No	++++ (2 wks. later)	
Two	5 days	No	None	
One	5 days	No	None	
One	6 days	No	None	
One	6 days	No	.....	Has been sent for Wassermann test; think there is a hard chancre at meatus
Two	7 days	No	None	
One	4 days	No	None	
Two	7 days	No	None	
Two	9 days	Yes, subsided	None	
Three	12 days, not healed	No	Positive	

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A small pledget of cotton is wet with 10 to 20 per cent. solution of cocain and applied to each lesion. After four or five minutes the field is carefully cleansed with soap and water and dried. Each lesion is then thoroughly wiped out with a cotton wound applicator until bleeding ensues. This is arrested by sponging, and when only serum exudes from the wound, this is collected for examination by dark field or stain, as may be the choice of the operator.

A 25 per cent. solution of copper sulphate in distilled water is now applied to the sore, and the short high frequency spark from a rather fine-pointed vacuum electrode is applied directly to the sore for one to three minutes, depending on the extent of the ulceration. Especial care is exercised in carrying the point of the electrode well down into any fissure or undermined edge, and the area of application should extend over the edge of the sore about one sixteenth inch into the doubtfully healthy area.

The current is not turned off until every crack and crevice has been thoroughly treated and the surface of the sore is changed to a dark greenish gray. It is then wiped dry and some antiseptic powder is lightly applied to the entire mucous surface of the preputial cavity. If the sore is exposed, it should be covered with a thick moist dressing, for which any very dilute antiseptic solution may be used, as a 1 : 10,000 or 1 : 20,000 mercuric chlorid solution; or even tap water answers nicely in most cases. This should be changed once or twice daily, and must not be allowed to stick.

The patient is instructed to return in two days, and, if the work has been carefully done, the wound will present a perfectly healthy granulation that will go on to complete healing in a few days. If the sore does not look clean, the application is repeated at the second visit. The patient returns each second day. If the original sore was large, or if a small sore does not seem to be closing rapidly, we have made it a practice

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to apply, at each visit, either a 10 per cent. copper sulphate or a 5 per cent. silver nitrate solution. We do not hesitate to repeat the original cauterization at any time we have reason to think the chancroidal infection is not completely eliminated.

The complete success of this, as of any other method, is dependent on careful, thorough work. There is more danger of too little cauterization than of too much, and thorough cleansing at the time the sore is destroyed must not be forgotten. Again, the after-care, especially with ulcus molle outside the preputial cavity, and with ulcus molle miliare, is of the utmost importance. If one fails to carry the electrode to the bottom of the cavernous ulcer, then one is lost. It heals over the surface, and in two or three days breaks out anew, larger and deeper than before.

If the dressing on an exposed surface is not changed once daily, and moistened at least three or four times, in many cases one will not succeed.

The accompanying table gives our results in all cases in which data are complete. A number of patients failed to return after the first treatment. Several of these have been seen later, and reported uneventful healing in a few days. In no case have we been able to record a failure.

Three or four cases in which the lesions did not heal well or recurred later developed a positive Wassermann reaction, notwithstanding the fact that careful microscopic examination was negative for spirochetes.

To be thoroughly scientific, one should always be able to explain and prove the modus operandi of any treatment presented to the profession. Unfortunately, we are not able to do just that, but we believe that by this combined treatment we have been able to produce deep sterilization of the chancroid ulcer with a certainty not heretofore effected. This has been done with great satisfaction to ourselves and our patients.

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We present the method with the hope that our friends may find in its application the same assurance of success that we enjoy.

1212 Kresge Building.

ABSTRACT OF DISCUSSION

Dr. Noah E. Aronstam, Detroit: The method of procedure in the treatment of chancroids as outlined by the essayists is neither novel nor unique. Old French authors on the subject as far back as 1880 advocated the use of strong solutions of copper sulphate. In the Allgemeine Krankenhaus of Vienna the same method was pursued twenty-five years ago. In the issue of 1902 of the *Russkiy Vratch* a similar method was mentioned.

The use of the high frequency tube on the lesions after the preliminary cauterization with copper sulphate is somewhat obscure and questionable to me. A pellicle is formed after such procedure on the sore, and hence the violet ray is unable to diffuse or penetrate and thus sterilize the lesion. My experience has been that it requires an untreated and unmolested lesion in order that the ray may prove efficacious.

As regards the varieties of chancroids, I am in the habit of classifying them as follows: (1) simple erosive chancroid; (2) miliary ulcer, or ulcus erosive miliare; (3) serpiginous form; (4) phagedenic; (5) pultaceous or necrotic; (6) gangrenous.

In the last four varieties the prognosis is unfavorable; the lesions prove very obstinate. Even in the simple variety a definite prognosis cannot always be ventured, and we should be guarded in expressing a decided opinion. There is no uniform method by which we can accomplish results. In my hands equal parts of phenol and iodin have proved useful. I refrain from using such caustic agents as strong solutions of silver nitrate, nitric acid and the methods promulgated by the authors for fear of inducing an indurated condition which may closely resemble the primary lesion of syphilis and thus mask and obscure the clinical features of the sore.

I wish to lay stress on the employment of bacterins in chancroidal lesions. I use a mixed staphylococcus vaccine, as frequently the chancroid harbors a mixed infection, superimposed on its causative agent, the Ducrey-Unna bacillus. I also desire to object to the term "chancroid." It should be changed to infective venereal ulcer, and the inadequate and antiquated term "chancroid" should be abolished.

Dr. H. L. Kretschmer, Chicago: The results that Dr. Robbins obtained with his combination treatment are better than the results we have obtained. We have been using the copper in 25 per cent. solution, preceded by 95 per cent. phenol, then applying the wet dressings just as he has done;

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that has given us very satisfactory results. I should like to ask Dr. Robbins how much of his good results he attributes to the action of the caustics and how much to the action of the high frequency current. I should like to ask whether or not in any of the cases of multiple chancroids he cauterized some of the lesions with copper and used high frequency, and treated some with the high frequency alone.

Dr. Charles W. Bethune, Buffalo: I should like to ask Dr. Robbins whether he obtained his high frequency current from the regular, standard high frequency machine which we use in fulguration, or from one of these small machines costing about $35. Is the latter sufficient to cause the penetration of the copper sulphate?

Dr. Robbins mentioned the use of mercurials in the treatment of chancroids. One can never tell absolutely that there is not a double infection with the spirochete. In that case one may mask the secondaries, possibly the general adenitis, and very probably the Wassermann reaction.

Dr. B. S. Barringer, New York: Dr. Livermore of Memphis, Tenn., sometime ago suggested that an ounce of argyrol crystals would cure all the chancroids in the United States, if properly applied. That was a rather vigorous statement, but we at Bellevue started to use the argyrol treatment. The ideal way that we found to use it was to cocainize the chancroid first and put argyrol crystals directly on it. Our results have been so good that we have practically given up every other form of treatment. We are rather inclined to agree with the gentleman who first published this statement.

Dr. Leland J. Boogher, St. Louis: This subject has been the *bête noire* of all of us. I have seen some cases that I did not believe any form of treatment would touch, and I remember one or two cases that ran on for a year or two until the tissue was almost entirely denuded. I have used crystals of argyrol and also another proprietary silver preparation. There are some cases in which I would like very much to have Dr. Robbins try his form of treatment. I have one such patient now, whom I have been treating about three months, and he is getting worse every day.

Dr. G. G. Smith, Boston: No one has yet mentioned the use of the actual cautery for very severe forms of chancroid, and I should like to mention it as having been in our hands a real weapon of reliance in cases which were not to be cured by applications of phenol, nitric acid and other caustics. We have had to anesthetize the patient either locally or by gas, and then apply the actual cautery until the whole thing is burned out to a dry crisp. I have seen some chancroids which resisted one treatment of that kind, but a second treatment always cured them.

Dr. Irwin E. Colgin, Waco, Texas: I have used a high frequency spark, using an electrode which approached the

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roentgen ray, and have had some very good results, but I think Dr. Robbins' method is superior to this, due to the fact that the copper in 25 per cent. solution will act as a conductor. The ordinary effleuve from a high frequency electrode, using a long spark, cauterizes the surface, and I do not doubt that using an electrode in conjunction with the copper sulphate in 25 per cent. solution would cause the current to be carried to a greater depth and would sterilize deeper than if the electrode were used by itself.

Dr. F. W. Robbins, Detroit: In this class of cases we have tried copper sulphate, Dr. Morton's use of zinc chlorid, high frequency—all these various things alone, without unusual results. Is there any one here who has not seen a chronic ulcer of the inguinal region, after a bubo has been opened, that has run on and on, the patients looking tuberculous and the condition continuing in spite of everything done? One such patient was in the hospital and in bed from four to six weeks. We used argyrol crystals and tried to cleanse that wound as thoroughly as possible, but without success as far as results were concerned; the patient simply remained in the same condition with this miserable sore that would not heal. Within a week after combined treatment was instituted the ulcer had healed and he was well.

Dr. Aronstam mentions the former use of copper; that is all right; but whether they used any strong metalic caustic in connection with the high frequency I very much doubt, because in those days they had no knowledge of high frequency or violet rays.

As to the machine from which we obtained this current, I use the Wappler larger battery; Dr. Seabury uses the smaller portable one. One is just as effectual as the other.

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EXTERNAL URETHROTOMY AND SEMINAL VESICULOTOMY

COMBINED IN A SINGLE OPERATIVE PROCEDURE

EUGENE FULLER, M.D.
NEW YORK

In an extensive and continuous personal experience with seminal vesiculotomy dating since 1901, complicating surgical conditions have naturally many times been encountered which tend to render the operation difficult, and in the class of cases now to be considered, existing complications were such as formerly either to bar me from performing vesiculotomy or else to force me to undertake that procedure only as a late sequel to other surgery. In early articles bearing on the surgery of the seminal vesicles, I have been careful to emphasize that it is often necessary to resort to catheterization in the after-treatment, and that consequently the urethra should be explored before operation to determine that no obstruction to the passage of a catheter exists. In cases in which catheterization has not seemed feasible, I later advocated opening the floor of the bladder between the seminal vesicles for introduction and retention of a catheter to drain the bladder. In 1910 I called attention[1] to this procedure and the uses to which it could be put. Postprostatic cystotomy does not contemplate a repair or correction of an existing urethral lesion. It simply serves as a means of avoiding the passage along the urethra of an instrument during the few days subsequent to a seminal vesiculotomy when such instrumentation may be called for to relieve retention.

1. Fuller, Eugene: Post-Prostatic Cystotomy, Med. Rec., New York, Oct. 22, 1910.

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The class of cases to be here considered are those in which a severe lesion of the seminal vesicles coexists with marked disorganization of the deep urethra. Acute or chronic systemic sepsis is the resulting complication which most frequently forces the surgeon to prompt action in these cases, though retention of urine, complete or partial, may be the impelling cause. Hitherto when the surgeon has been forced to act in this connection, his object, as a rule, has been simply to establish free urinary drainage, thus partially relieving the patient for the time being. This palliative surgery may save life and by so doing allow the patient to drift back into a state of invalidism. The reason for this is that not all septic foci are thereby eliminated.

My former method of dealing with these cases was by resort to two or perhaps more separate surgical procedures. In case of acute retention combined with acute sepsis, the perineum would be opened freely and also a suprapubic vesical opening might be made, should free urinary drainage not be otherwise assured. In such a case two other subsequent operations would probably be demanded to insure complete recovery, namely, seminal vesiculotomy and a repair operation in connection with the urethral lesion. In cases in which the urethral obstruction was not complete and the sepsis not of a grade of extreme severity, I often performed first a seminal vesiculotomy combined with postprostatic cystotomy, and then later as a second operation external urethrotomy and a repair of the urethral lesion.

There were various objections to treating these cases by multiple operations, aside from the chief one already mentioned of the failure promptly to eliminate all septic foci. Such failure materially increased the risk as regards mortality, and besides this, in a case still septic, surgical repair following a primary operation was slow and unsatisfactory, inviting per-

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sistent fistula in connection with urinary drainage and nonunion where plastic repair work had been attempted. When a patient has been through a severe illness and a surgical ordeal, it is often difficult to get him to consent to necessary supplemental operations in the near future, or at least I have so found it, a result being that the patient may finally leave the hospital still suffering, generally dissatisfied with what has been done for him, and strongly inclined to seek other surgical advice. On several occasions I found a second operation demanded as an emergency measure before convalescence had been established following a primary procedure. This occurred mostly in cases in which inflammatory exudation about a deep urethral lesion increased rather than diminished after the bladder had been drained through a postprostatic cystotomy. In the majority of instances, when the passage of the urine is diverted from the urethra, improvement follows in connection with the inflammatory status of a urethral lesion; but in these minority instances the exudation increased sufficiently to block the urethra, thus causing retention as soon as the postprostatic vesical opening closed. The development of such an emergency is objectionable from a surgical standpoint, and should be avoided if possible. These surgical objections were sufficient to lead me to treat cases of this description by one radical and combined surgical procedure undertaken as a single operation. My experience in so doing has been highly gratifying.

The combined operation cannot be performed by maintaining the body of the patient in one position on the operating table. One change is always required, and often a further change is desirable. In the latter cases, however, a further change consists simply of a shifting of the body back from the second position to the original first position in order the better to adjust drainage tubes and packing. My operative technic in

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connection with seminal vesiculotomy has already been fully reported.[2] The same can also be said regarding the surgery employed in connection with the deep urethra.[3] In the combined operation the patient is first placed in the knee-chest position for drainage of the seminal vesicles and of the adjacent postprostatic extravesical region, provided such area has become involved. After gauze packing has been adjusted, the patient is then turned into the lithotomy position, the perineum incised by a free median incision, the deep urethra opened, and the neck of the bladder freely incised. The next step of the operation is to treat or repair the existing lesion of this part. This may call for urethral resection, the elimination of urethral false passages, the drainage of areas of suppuration, etc. The maintenance of perineal vesical drainage by the insertion of a rubber tube is always a feature of this operation. When active suppuration is present it may be necessary to leave the perineal wound open and packed with gauze; otherwise it is often feasible after repairing or eliminating lesions to close the perineum with the exception of the opening left for the passage of the vesical drainage tube. When the perineum is closed, it is often necessary to maintain in the urethra a drainage tube to act as a splint as described in my article[3] already referred to in dealing with the surgery of the deep urethra. Aside from those, there are two tubes necessary in connection with the seminal vesiculotomy. All packing and sutures are removed at the end of five days, and the tubes generally at the end of ten days after operation. In order to illustrate and to make clear the necessary field for this combined surgical operation, the clinical history of a few cases will be recited.

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2. Fuller, Eugene: Extraperitoneal Rupture of the Bladder: Its Surgical Management, THE JOURNAL A. M. A., Dec. 12, 1914, p. 2114; Drainage of Extravesical and Extraperitoneal Suppuration of the Male Pelvis, Oct. 25, 1902, p. 1021; Med. Rec., New York, 1913, **84**, 691.
3. Fuller, Eugene: Med. Rec., New York, April 2, 1910.

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REPORT OF CASES

CASE 1.—A man, aged 36, entered the City Hospital with retention and in a septic condition. He had been well until about a month before, when he contracted his first gonorrhea. Examination revealed bulging periurethral abscess just anterior to the penile scrotal junction. The perineum was swollen, brawny, and tender to the touch, evidencing deep suppuration also in that region. Rectal exploration revealed great tumefaction, tenderness and heat, involving the entire postprostatic area. It seemed plain that there were three independent foci of active suppuration, and that thorough drainage of these together with the bladder were promptly demanded to save life. The patient was put in the knee-chest position. The seminal vesicles were opened together with the periseminal vesicular tissues. About 4 ounces of pus were liberated. The patient was then put in the lithotomy position and the perineum opened freely. A large amount of pus was liberated by this incision. After the bladder had been opened for drainage, this region was packed. The periurethral abscess was next opened by an incision through the urethral floor. This thorough procedure combated the systemic sepsis. The patient left the hospital in a very satisfactory condition.

CASE 2.—A man, aged 45, entered the City Hospital chronically septic and so rheumatic that he walked with great difficulty. Both ankles were tumefied red and very tender to the touch. There was hardly any control of urination, and there was much frequent vesical tenesmus. Control of the bowels was uncertain. There was more or less continuous rise of temperature. The patient had been strong and vigorous till about three years previously, when he contracted gonorrhea. The history was that retention followed, and that the bladder had been opened and drained by way of the perineum, leaving the patient in the present condition. Examination revealed considerable scar tissue in the perineum and some induration. Manual examination through the rectum revealed the entire postprostatic space filled with indurated tissue which completely enveloped the seminal vesicles, extending forward into the prostatic capsule and laterally to the borders of the pelvic space. This extensive lesion involved the trigonum, causing marked pericystitis. There was disorganization of the deep urethra, it being difficult to pass an instrument into the bladder owing to a sulcus or pouch on the floor and just anterior to the prostate. The seminal vesicles were opened and free dissection made into the surrounding tissues. The perineum was then opened, the sulcus dissected out, and the prostatic fibers encircling the vesical neck cut through, this incision being extended backward so as to include the anterior portion of the trigonum, which was also involved. The patient made an extremely

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satisfactory recovery. All the septic and inflammatory conditions disappeared, together with the pericystitis. He left the hospital comfortable and with good control of the bladder.

Case 3.—A man, aged 38, entered the City Hospital with difficult, frequent and very painful urination. At times the urgency was so great as to occasion persisting vesical tenesmus. Chills and fever were prominent symptoms. There were marked perineal pain and general distress referable to the pelvic, sacral and hypogastric regions. There was a history of early gonorrheas and urethral stricture. There had been much urethral instrumentation, and on two occasions there had been perineal operations for stricture. Each operation had apparently served to increase the symptoms of discomfort, and for a long time past it had seemingly been impossible to pass instruments into the bladder. Instruments passed along the urethra were deflected into one or more false passages. There was much induration in the perineum. Rectal examination revealed extensive hard cicatricial involvement of the prostate and seminal vesicles. Such involvement also included all the postprostatic fibrous structures, indicating that formerly there had been extensive suppuration in this region. An attempt to repair the urethra by operation, neglecting the lesion involving the seminal vesicles, would, it then seemed to me, invite another failure. Accordingly seminal vesiculotomy was first performed, and then the perineum was opened, the urethra partially resected, the false passages eliminated, and the rigid contracted neck of the bladder cut through. The patient made such a complete recovery that he left for France, expecting active military service.

Case 4.—This patient was a man, aged 70, whose chief symptoms were severe perineal pain often involving the rectal region. During periods of exacerbation, the pains would radiate down the thighs and into the hypogastric and sacral regions. Urination was difficult and frequent. The stream was slow to start and lacking in force. On several occasions retention had occurred, necessitating the passage of a catheter. There was no urethral obstruction. The bladder was considerably contracted, any distention over 6 ounces causing great pain. Aside from an old chronic streptococcus infection, the urine showed nothing abnormal. The present symptoms had commenced twenty-five years previously. As a young man he once had gonorrhea. The senior Otis had operated on the patient's anterior urethra many years before, but nothing that had ever been done for him had apparently resulted in relief. There had been a frequent resort to opiates, and when he came to me the drug habit in a moderate degree was established. Years ago there had been considerable discomfort from priapism, and sexual indulgence had

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then increased his discomfort. For years there had been no such indulgence. There was no tuberculous history. Rectal examination revealed the prostate atrophic and very sclerous. The seminal vesicles were tumefied, very sclerous, and so sensitive to the touch that the patient cried out with pain, asserting that therein lay the seat of his pain and discomfort. There was marked rigidity and contraction of the prostatic neck of the bladder. A bougie à boule could be easily passed into the bladder, but its extraction was difficult, as the shoulder of the instrument caught and was held by the contraction. Cystoscopic examination revealed the bladder trabeculated. The surgical indications were to open the seminal vesicles and to cut through the contracted prostatic neck of the bladder. When the seminal vesicles were opened, numerous small calculi were found in each to account for the extreme pain and sensitiveness. Next the perineum was opened, the vesical neck incised, and a tube inserted into the bladder. The structures making up the rectal wall were thin and atrophic; and this, in view of the age of the patient, caused me to make a counter suprapubic vesical opening to insure especially free drainage, and the more to guard against postoperative tenesmus. I had a fear that sloughing of the rectal wall might result should there be unnecessary tenesmus following the operation. The operation was highly successful, the patient leaving the hospital free from pain, and voiding urine without obstruction.

COMMENT

My present experience with this combined surgical procedure is confined to ten cases, in nine of which the patients recovered satisfactorily. The one who died was septic before operation, owing to streptococcus involvement of both seminal vesicles. Aside from this, some prostatic hypertrophy had to be removed when a contracted vesical neck was incised. In this case, on the seventh day after operation, when convalescence was seemingly established, persistent hemorrhages occurred, suggestive of hemophilia. The patient died about one week after the occurrence of the first hemorrhage, horse serum and thyroid having no seeming effect.

ABSTRACT OF DISCUSSION

Dr. E. O. Smith, Cincinnati: We are all familiar with Dr. Fuller's work on the seminal vesicles and his particular method of perineal drainage with the urethral splint. I have used this method, but not in this particular group of cases.

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It was in cases in which there were persistent fistulas that could not be closed otherwise, and in which there was no particular inflammation of the vesicles. I can readily understand how this method would be very valuable in the class of cases presented by Dr. Fuller. Of course, we do not see a great many cases that have three foci of infection at one time, but it is purely a matter of common sense to open all the sources of infection. The simple opening of the perineum in the particular case reported would not have given the patient relief, because the seminal vesicles were also foci of infection.

Dr. R. H. C. Gibbons, New York: I am glad to know that Dr. Fuller has added external perineal urethrotomy to his theretofore most successful operation of vesiculotomy. A young man contracted gonorrhea. His family physician treated him. He told the patient to take plenty of water, plenty of milk, no stimulants, no tobacco, etc., and no injections, and in due time he got well, apparently. Later he contracted another infection. He then went to a general surgeon who used sounds, etc., and still the discharge kept up. Then he went to a general practitioner, who instilled silver nitrate into his deep urethra and cleared up his discharge in five to ten days. Then he began to have distress and suffering, and became wretched and miserable. He had boils here and there, so-called abscesses, and eventually he went to Eiselsberg's famous clinic in Vienna, where he was subjected to various tests, and Eiselsberg told him he did not know what the trouble was, but thought there was a piece of bone in his rectum. He had an abscess in his rectum. A prominent genito-urinary man in New York saw him repeatedly, and many Wassermann tests were made, with a diagnosis of syphilis. Finally another general surgeon found a tumor and cut into it. He then came into my hands. I made an examination and thought he had sacro-iliac disease, but the next day I changed my mind and thought it was all due to a vesiculitis, and asked him to go to Dr. Fuller, which he did not do for some time. In Chicago another surgeon examined him, and said: "Young man, you've got tuberculosis, and you've got to go away to live out of this country; go where there is plenty of sunshine." He came back to New York and told me what this gentleman had said. I called in Dr. Virgil P. Gibney, who convinced him that he had no such trouble. I then had him see Dr. Fuller. He was fairly well then and Fuller advised him to wait a year. At the end of a year Dr. Fuller dissected out the vesicles. If that operation had been done at the opportune time all this misery, suffering and suspense would have been saved. The patient got well, except that he had a peritonsillar infection, which I attributed to the trouble in the genito-urinary tract. The tonsils were removed.

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Dr. Eugene Fuller, New York: This paper deals with a method which has not hitherto been described. I put it on record as an efficient method of dealing with a class of cases which had not received curative attention, as I think you will agree if you are in institutions where you get hold of such patients as we do at the City Hospital. Many patients are sent there with the expectation that they are surgical lemons, but in reality they are the very best cases to tackle, because to get results one has to do something a little better than the preceding fellows. Many of the cases under consideration have been straightened out; most of the patients had gone the rounds of the best hospitals and had fetched up at the City Hospital as the last resort. One of them is now doing his bit fighting at the front.

When I first employed this procedure I felt that opening the seminal vesicles and then the deep urethra, at the same time splitting the prostatic neck into the trigonum, looked radical, and it is radical. You hear men say, "That is too radical," and perhaps that "he is a butcher," etc., but I think that sort of comment is rather a compliment to a man than otherwise if his patients get well. I hope the gentlemen of the section will try to manage these cases along this line, and not be afraid of the free openings any more than one need be afraid of the free opening of an abscess.

The case that Dr. Gibbons spoke about was extremely interesting, because that man had, primarily, suppuration in connection with his seminal vesicles, and this suppuration had seeped its way through the bony structure of the back above the sacrum and had pointed outside. I had never before seen such suppuration so pointing. A dorsal incision had previously been made and a piece of the sacrum had been chiseled out, on the assumption that the bony structure was the primary seat of the disease. In the performance of seminal vesiculotomy in this case I found certainly over an inch of dense fibrous tissue to be incised before reaching the focus of the seminal vesicle abscess. We drained it—that was several years ago—and I feel that I did not drain it sufficiently long as the man was slow in getting well. I think in a case like that in which the abscess walls were so thick, it would be well to keep the drainage tube in for a couple of months rather than the customary ten days.

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BLADDER DISTURBANCES DUE TO NERVE LESIONS

GILBERT SMITH, M.D.
BOSTON

The occurrence of bladder disturbances as the early or predominant symptoms of certain rather unusual nerve lesions was called to my attention by two cases, one of syringomyelia and one of multiple sclerosis. Unless the possibility of such an etiology is borne in mind, the urologist may fail to find the reason for the persistence of certain abnormal conditions in the bladder.

Search through the literature of the past four years failed to reveal more than three papers on the subject written from the urologic point of view.[1] Caulk and Greditzer[2] call attention to the relaxation of the vesical sphincter in tabes dorsalis, dementia paralytica, tumor or gumma of the spinal cord, postapoplectic conditions, exophthalmic goiter, paralysis agitans, lead poisoning, and the continuous retention catheter.

Koll[3] and Greenberg[4] have both written about the diagnosis of nerve lesions by the use of the cystoscope, but nowhere in urologic writings have I found reference to the vesical aspects of certain diseases of the nervous system. Boxwell,[5] a neurologist, has published a brief but fairly comprehensive discussion of the subject, and mentions instances of vesical disturbance

1. Since this paper was written, my attention has been called to two articles bearing on this question. Lewis, Bransford: Contra-Indications to Surgical Intervention in Obstruction at the Vesical Neck, Tr. Am. Urol. Assn., 1915, p. 274; Studies in Obscure Forms of Prostatic Obstruction and Vesical Atony, ibid., 1914, p. 13.
2. Caulk and Greditzer: Observations on the Bladder in Diseases of the Central Nervous System, Interstate Med. Jour., 1916, **23**, 36-41.
3. Koll: Study of Twenty-Five Tabetic Bladders, Surg., Gynec. and Obst., 1915, **20**.
4. Greenberg: Cystoscopy as a Diagnostic Aid in Spinal Disease, Med. Rec., New York, 1916, **90**, 634-636.
5. Boxwell: Disordered Bladder Function, in Nervous Diseases, Tr. Roy. Acad. of Med., Ireland, 1914, **32**, 63.

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in cases of myelitis, alcoholic neuritis, hemiplegia and tabes. According to the neurologists, bladder disturbances are frequent and sometimes early accompaniments of various nerve conditions which are not mentioned by urologists. It would seem probable that some of these patients are seen first by the latter, and possibly, in the course of routine treatment, escape a correct diagnosis.

The exact relationship between disturbances of the bladder function and the pathology of nerve lesions is not always clear. In fact, the physiology of the normal act of urination is not absolutely definite. Langley and Anderson[6] have shown that the bladder in cats, dogs and rabbits receives motor fibers (1) from the second to fifth lumbar nerves, the fibers passing through the inferior mesenteric ganglion and reaching the bladder by way of the hypogastric nerves, and (2) from the second and third sacral spinal nerves, reaching the bladder by way of the nervi erigentes and the hypogastric plexus. The nerve fibers from the sacral cord seem to be more actively concerned in the reflex of urination; stimulation of the lumbar fibers sets up only gentle contractions of the bladder.

The classical work of Goltz[7] in 1874 established the general principles of the vesical reflex. He pointed out that gradual distention of the bladder induced gentle contractions. These expressed several drops of urine into the posterior urethra, causing thereby a sensory stimulation. This — the afferent part of the reflex — aroused the efferent impulse by which the bladder is made to contract vigorously and the sphincters to relax. Goltz showed that in dogs with spinal cord severed between dorsal and lumbar regions the reflex still existed, and that it persisted even when the lumbar cord was entirely destroyed. Thus it was established that the act of micturition is a reflex of a very primitive type, requiring not even a spinal center.

6. Langley and Anderson: Jour. Physiol., 1895, **19**, 71.
7. Goltz: Arch. f. d. ges. Physiol., 1874, **8**, 478.

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The problem is complicated, however, by the fact that this reflex is very completely under the control of the will.

Before the bladder is anywhere near full, one can initiate the act of urination. By consciously relaxing certain perineal muscles and contracting others in the abdominal wall, one probably squeezes out the first few drops, which are sufficient to set the reflex in motion. The act then becomes automatic, unless, by a definite exertion of the will power, one closes the external sphincter and holds it shut until the contractions of the bladder have ceased. Conversely, when the bladder is overdistended, and urine squeezed into the posterior urethra sets in motion the reflex, the carrying out of the reflex can be prevented by an exercise of will power.

It is evident that the nerve mechanism of micturition is vulnerable at several points. If the roots of the sensory nerves are affected, as in tabes, the reflex arc is broken. If communication between the lower centers and the brain is interrupted, the act should theoretically become purely reflex and should be free from the inhibitive influence of the brain.

In general, disturbances of the bladder due to nerve lesions take one of several forms:

1. Those due to irritation of the sensory nerves, giving rise to frequency, urgency and hyperesthesia of the bladder neck. This occurs sometimes in tabes, in syringomyelia and in multiple sclerosis.

2. Retention, partial or complete, due to spasm of the external sphincter. Barney[8] explains this phenomenon in his careful work on tabes dorsalis. This condition occurs in other diseases besides tabes—in multiple sclerosis for example. It may be followed by dribbling from an overdistended bladder, but this is due primarily to retention.

8. Barney, J. D.: The Care and Management of the Tabetic Bladder, Boston Med. and Surg. Jour., 1910, **163**, Nos. 25 and 26; 1911, **164**, No. 1.

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3. True incontinence due to paralysis of the sphincters. This occurs in later tabes, in transverse myelitis of the lumbosacral region, and in syringomyelia.

4. Involuntary micturition. This may occur when the lower centers are cut off from the higher, as in trauma of the cord or in transverse myelitis, when these lesions are situated above the lumbar segments. The bladder will empty itself when the stimulus caused by increasing distention becomes sufficient.

Probably the most common disturbance of the bladder from the neurologic point of view is tabes dorsalis. This subject was worked up by Barney in 1910, and little can be added today to his thorough exposition. It would be unnecessary to take up the reader's time by a recapitulation of the well known course of that disease.

The only extraordinary cases which I found reported were those of tabes in children, described by Barkan.[9] He speaks of a girl of 9 years with tabes and nocturnal enuresis, and says that he has seen twelve cases of tabes in children within two years.

Another lesion of the spinal cord which may cause bladder disturbance is myelitis. If the lesion occurs in the lumbar cord, according to Gowers,[10] it will cause loss of vesical reflexes which results in dribbling without retention. If above that region, the reflex is first lost, and then becomes hyperactive. In other words, there is first retention, then involuntary voiding.

Trophic disturbances in myelitis may cause ulceration of the bladder.[10]

Syringomyelia is the occurrence of a glia-lined cavity in the gray matter of the cord. The symptoms are necessarily variable, depending on the location and size of the cavity. Jelliffe and White[11] speak of the loss of sexual desire and of testicle pains which occur.

9. Barkan, H.: Infantile and Juvenile Tabes, California State Jour. Med., 1914, 12, 488-491.
10. Gowers: Diseases of the Nervous System, 1903, 1, 247, 361.
11. Jelliffe and White: Diseases of the Nervous System, 1915, p. 355.

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They refer to analgesia of the bladder and persistent priapism as occasional symptoms. In regard to bladder disturbances, they say that these "are not the rule, although at times appearing, usually late in the disease. When appearing early, they are apt to be transitory. They may be sensory or motor, irritative or paralytic. Cystitis is not infrequent in the later stages of the disease." With the dorsolumbar type of the disease, involvement of the bladder and rectum is not infrequent, while in the sacrolumbar type, it is usually present.

A patient with syringomyelia exhibiting marked bladder symptoms entered the Massachusetts General Hospital on the genito-urinary service in October, 1916. The relation between the vesical disturbances and the nerve lesion was not perfectly clear, yet we were unable to account for the former in any other way. The patient was a woman of 30, a domestic who had had three illegitimate children. Two of them were born dead; the last one, which lived, was born five years before. The patient complained of painful, burning micturition of eight weeks' duration. Urination was followed by dribbling, tenesmus, and a desire to urinate again. The urine contained pus and colon bacilli. Cystoscopy was done under spinal anesthesia. Considerable trabeculation of the bladder wall with a distention of 6 ounces was noted. Both ureters were catheterized; a small amount of pus and a growth of colon bacilli were obtained from each. Roentgenoscopy and the Wassermann test were negative. The peculiar thing was that during her twelve days in the hospital, the patient continued to have constant severe spasms of the bladder, in spite of every kind of local treatment. Also, she had, on several separate observations, a residuum of 6 ounces.

She was seen in consultation by Drs. Taylor and Paul, who made the diagnosis of syringomyelia, because of atrophy of the small muscles of the hands and various sensory disturbances.

Multiple sclerosis, or disseminated sclerosis, is characterized by the occurrence of small patches of sclerosis in the spinal cord, or brain, or both. These patches are due to the degeneration of the included nerve tissue, which is later replaced by neuroglia. Their size varies from that of a pea to that of a walnut, and they involve the white matter primarily. Sometimes the nerve roots are affected as well.

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The etiology of this condition is unknown. It occurs most often between the ages of 25 and 35 years, and although naturally the symptoms vary according to the location of the patches, the most usual symptoms are loss of muscular power in the limbs, a jerky incoordination, nystagmus, and staccato utterance. The individual is prone to outbreaks of emotion, manifested either by laughter or by tears. Babinski's sign is always present; the absence of abdominal and epigastric reflexes is a valuable point in the diagnosis (Gowers[12]).

The importance of this disease to the urologist is suggested by the words of Collins and Baehr.[13]

> Frequently there is associated a weakness of the bladder; there is inability to hold the urine as well as usual, and there may be urinary incontinence at times. . . . Urgency is an early symptom, and is due to hypertonicity of the bladder muscle. Intense spasms of the sphincter may occur, causing retention; later in the disease, incontinence is present practically always.

Sixty-five per cent. of Collins and Baehr's cases were of the spastic type, usually accompanied by bladder disturbances. Jelliffe and White[14] say that the bladder is involved in from 75 to 80 per cent. of all cases. "The patient feels a sense of insufficiency, and has to strain to pass water. Complete paresis with incontinence is rare." The many ups and downs in the bladder symptoms are remarkable. The disease is progressive, with intervals of improvement, but care of the bladder as in tabes would seem to be indicated.

The bladder manifestations of multiple sclerosis described by these authors were reproduced with striking accuracy in the following case:

> M. C., a nurse, aged 28, was seen about one year ago. Four years before, while in training, she became "run down" and very nervous. Previously, she had always been well, except for measles. Accompanying her breakdown were bladder symptoms—great frequency and inability to hold the water. Association with insane persons led her to fear that she might

12. Gowers: Diseases of the Nervous System, 2, 543.
13. Collins and Baehr: Disseminated Multiple Sclerosis, Am. Jour. Med. Sc., 1914, 148, 495-520.
14. Jelliffe and White: Diseases of the Nervous System, 1915, p. 379.

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have some nervous disease, so she went to the Massachusetts General Hospital and had an examination of the spinal fluid. This was normal. She returned to work and has remained at it, in spite of a sense of weakness in the legs, and what she characterized as a "weakness of the bladder." At times she wet the bed at night.

She was a rather pale, tired looking girl. The pupils reacted normally. There was no Romberg; the knee jerks were normal; general examination was negative; the kidneys were not palpable; the pelvic organs were normal. The urine by catheter was hazy, revealing no sugar nor albumin. A centrifuged sediment showed some pus cells, a few red blood cells, and vast quantities of staphylococci. No tubercle bacilli were found. Roentgenoscopy was negative for stone.

The bladder contained 4 ounces of residual urine, with distention of 8 ounces; the bladder wall showed a fine trabeculation; the mucous membrane was clean. The ureteral orifices were normal. Both ureters were catheterized with a flow of normal urine.

Not being awake to the diagnosis, and finding the urethra abnormally red and granular, I treated her with urethral applications, sandalwood oil and bladder lavage. The residual urine remained about 4 ounces throughout July, August and September. In November, I noted that her chief trouble was fatigue in the front of the legs. The bladder symptoms improved a very little, the greatest improvement following rest from work, bromids and belladonna.

The patient was very emotional, laughing one moment, crying the next. On December 22, the residuum was only 1½ ounces. In December, I sent her to Dr. George Clymer for neurologic examination. He reported that he found a positive Babinski, negative abdominal and epigastric reflexes, and positive ankle clonus—in short, that she unquestionably had multiple sclerosis.

He started treatment with solution of potassium arsenite (Fowler's solution) and the application of electricity over the bladder. Whether or not as a result of this treatment, the patient showed remarkable improvement. The residuum cleared up, the urine became normal, and for two months she wet the bed only during menstruation. She has had a slight remission, but generally speaking is much better, and has started to work again.

I have reported this case at some length because it is a striking example of the vesical manifestations of multiple sclerosis. Bladder trouble was practically her only complaint, yet there was the definite background of a nervous disease which escaped detection on routine physical examination.

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The presence of residual urine should have suggested at once the necessity of a more thorough nerve examination.

Syphilis of the brain and cord, whether of the diffuse type or circumscribed, as in gumma, may produce disturbances of the bladder, varying with the location and extent of the lesion.

Tuberculous meningitis may do likewise. Pearson,[15] in 1902, and Moody[16] in 1916, called attention to the fact that retention of urine coming on in a person with tuberculosis is an early symptom of an invasion of the meninges. Moody quotes four cases, all proved by necropsy, in support of this theory.

Neuritis of alcoholic origin (Boxwell) may produce incontinence, and that postdiphtheritic neuritis can result in retention, the following case will show:

In 1909, J. K. (162960), aged 62, a laborer, was sent into the Massachusetts General Hospital from the outpatient department because he was found to have a residuum of 30 ounces. His only previous illness had been diphtheria twenty years before. At that time he had stoppage of water, and had had dribbling of urine, with pain at the beginning of urination, and he has had difficulty in starting the stream ever since. There was slight frequency at night. The reflexes were normal. The patient's general physical condition was negative except for some cardiac hypertrophy. The prostate was not enlarged nor tender. The catheter passed easily and drained 30 ounces of foul urine. He was seen by the consulting neurologists, who found evidence of nerve lesions. A cystoscopy was done by Dr. Lincoln Davis, who found nothing obstructive, and thought the bladder condition due to his diphtheria. Epididymitis set in, then pericarditis. He died, and at necropsy, the kidneys showed suppurative nephritis, the ureters and pelves were dilated, the bladder showed a thickening of the walls with fibrous induration in the region of the outer coat and much hypertrophy of the trabeculae. Between the hypertrophied trabeculae in several places, there were smooth walled diverticula, the largest being about 3 cm. in the greatest dimension. The prostate showed very slight, if any, enlargement of the lateral lobes. There was a very small eminence in the situation of the median lobe. The prostatic urethra was free and somewhat dilated.

15. Pearson: Retention of Urine in a Patient with Tuberculous Meningitis, Clin. Jour., December, 1902.
16. Moody: Retention of Urine in the Adult, Without Known Cause, a Sign of Tuberculous Meningitis, Lancet, London, 1916, 1, 104.

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That various forms of insanity are accompanied by disturbances of the vesical and rectal sphincter is, of course, well known; the bladder disturbances are usually late symptoms.

Not so much in them as in the field of organic nervous diseases, such as multiple sclerosis, syringomyelia and tabes, is cooperation between urologist and neurologist most necessary. The most troublesome symptom of those conditions may be vesical, and the first assistance sought by the patient may be from the urologist. It is well for the latter to have in mind the fact that a nerve lesion may be the cause of marked hyperesthesia of the bladder, characterized by great frequency, or of unexplained residual urine in cases without urethral obstruction.

ABSTRACT OF DISCUSSION

Dr. W. C. Quinby, Boston: I think it would be of value to place along side of Dr. Smith's results those of a rather hasty investigation of cases occurring in the last four years at the Brigham Hospital in Boston, in the service of Dr. Cushing, which showed definite bladder lesions and bladder symptomatology due to various known lesions of the cord. The bladder symptoms following these various spinal cord lesions depend entirely on the location and nature of the lesion; therefore we find the greatest difference in the symptoms, as has already been pointed out by Dr. Smith. In going over the cases at the Brigham I have chosen twenty which showed definite symptomatology in the bladder. These were as follows: 1 case of transverse myelitis; 3 cases of spinal cord endothelioma; 1 case of spinal cord angioma; 1 case of metastatic sarcoma; 1 bullet wound of the cord; 12 cases of fracture of the spine; 1 case of hematomyelia without fracture of the spine.

I wish to call attention merely to the broad deductions and conclusions which one can draw from a study of these cases, without going into the details at this time.

A lesion at the proper level to cause a complete paraplegia always involves the bladder, causing a paralysis of the detrusor, with resulting retention of urine. Following this, at a later or earlier period according to the severity of the injury, there supervenes incontinence with overflow; then, later on, if the patient lives and the condition persists, true incontinence, with a greater or less degree of residual urine, is usually seen. Sooner or later infection always occurs. Sometimes it occurs with startling severity, with symptoms

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and signs of infection of the kidney and bladder of greater intensity than those signs from the spinal lesion, and death ensues. In other cases, however, the infection may be partly resisted by the patient, and fairly often cases occur showing a chronic cystitis and pyelitis from time to time, increasing in intensity and causing symptoms of general sepsis.

The extradural tumors cause cord lesions of less severity than the fractures. In such cases, depending on the location and the amount of pressure, one finds varying degrees of bladder involvement. The mildest form of bladder involvement seen is inability to start the urinary flow on demand. One patient said that the effort to urinate had to be persisted in from five to eight minutes before the stream could be started. This seems to be the earliest sign of vesical disturbance, and it is followed later by the more definite sign of great bladder irritability.

In cases of paralysis of the bladder, where function is returning, the earliest sign of this return is apparently the ability to know when the bladder is full. The patient who has before been absolutely unable to judge the degree of distention of his bladder, with returning nerve power recovers this ability. He is still quite unable to perform voluntary urination, however.

I have just one suggestion to make, and may almost put it in the form of a plea; this is in regard to the treatment of infection. Apparently infection is inevitable in this severe type of case of which I am speaking. If we agree, as I think we must, that the frequent catheterization of such patients, or the presence of an inlying catheter, leads to earlier infection and is harder to handle than a suprapubic puncture of the bladder, then we are logically compelled to make a suprapubic cystotomy at the earliest possible time. I have had personal experience with two such patients in whom, following fracture of the spine, a suprapubic cystotomy was made. Infection resulted, to be sure, but it was very slight, and each of these patients has now practically recovered and the bladder has been allowed to close. One of them still bears a mild degree of cystitis due to the colon bacillus. I am sure that early suprapubic drainage of the bladder in these severe spinal cases is of the utmost importance.

Dr. Bransford Lewis, St. Louis: There is one phase of the subject of involvement of the mechanism of urination that is interesting rather more from the urologic standpoint, and I read a paper on the subject before the American Urological Association about three years ago, under the title of "Studies in Obscure Forms of Prostatic Obstruction and Vesical Atony" (Ann. Surg., March, 1915). During the last ten years or so there have appeared from time to time discussions of prostatic obstruction by very able men, like Thomson Walker of England, Albarran and others, and Germans of equal prominence, in which they spoke of cases of prostatic

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obstruction with what they termed unrecognizable causation. They, to their own satisfaction, excluded nervous origin and let it go at that—apparently what we used to term idiopathic, whatever that means. I discussed the subject and adduced a number of cases, and from my standpoint I could not believe there was such a thing as a retention of urine, atony and all those sequelae, without causation, and in the study of obscure forms of prostatic obstruction mentioned I declared they were due to certain physical conditions that were not recognizable according to the methods employed for diagnosis; such, for instance, as a moderate degree of contracture of the vesical neck that was not recognizable by the various methods of instrumentation, either endoscopic or cystoscopic, until one got one's finger right there and felt the contracture that until then was not recognizable.

Another form of obstruction that ought to be given more consideration, I said, was that of syphilitic influences through the spine, producing interference with the evacuation of the bladder without there being an evident tabes or any lesion that was apparent excepting on the most careful analytic study of the case. And that applied to younger individuals as well as to the old ones, and also to inherited syphilis. I spoke of one patient who had been subject to numerous surgical operations; he had had five major operations done on him, and he was only about 18 or 20 years of age when I saw him, and he had never been able to urinate with any degree of satisfaction. He had never acquired syphilis, but he did have inherited syphilis that had bestowed on him this stigma that had required all his attention all of his life. It was proved by the Wassermann and other tests, and he improved under the influence of antisyphilitic treatment. That was one of the obscure forms of prostatic obstruction that I insisted should be recognized, and that the Wassermann test, both of the blood and the spinal fluid, should be applied in all of these obscure cases. In a symposium on the same subject before the American Urological Association the following year (1916) I was asked to review the inoperable cases, cases of prostatic obstruction in which operation was not appropriate, and in those I named the various forms of nervous cases that caused an inhibition of urination. It might be that those cases will have some bearing on the question studied so thoroughly by Dr. Smith.

Dr. John T. Geraghty, Baltimore: In connection with Dr. Smith's paper and Dr. Lewis' discussion, I would disagree with Dr. Lewis. I was much astonished a few years ago to find some cases of obstruction to urination for which we could find no cause. We supposed, of course, that they were probably unrecognized cases of contracture of the vesical neck. Operation to divide the vesical neck, however, gave no relief. We have had now a series of six cases of that type in which all of the clinical findings were simply

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those found with a spinal cord lesion; sometimes dilatation of the vesical orifice, residual urine as a rule, and all of the classical symptoms that go with the spinal cord cases that Dr. Smith has mentioned. Two of these cases have come to necropsy, and we were able to obtain a most complete necropsy, including the central nervous system, and the most careful studies of the central nervous system, and the bladder and the urinary apparatus failed to show the slightest cause for the obstruction. There is only one explanation which I can think of which will account for these cases, and that is that we will probably have to admit the possibility of a peripheral lesion; that it is possible to have a peripheral neuritis which will affect the bladder. That is hard to understand, because if there is a degeneration of the peripheral nerves, sooner or later there should be evidences of that in the spinal cord. In these cases there was nothing in the spinal cord to indicate that the nerves had been injured. Furthermore, these two patients, instead of having atrophied bladders, had hypertrophied bladders. In each instance the vesical orifice was dilated; there was no valve formation, no diaphragm.

Dr. C. M. Harpster, Toledo, Ohio: The idea that trabeculation is one of the earliest premonitory symptoms in tabes I think is not absolutely substantiated. I should like to call attention to a very unique case the study of which it was my pleasure to take part in. This was of a man who had a fracture of the fifth and sixth cervical vertebrae. If I remember my anatomy correctly, the brachial plexus is made up of the four lower cervical and first dorsal nerves.

I was especially interested in studying the effect of this injury of the spine on his bladder phenomena. We studied this patient for about six months, and we could put him to sleep, make him cease talking and paralyze him from the neck down at will. That is, we had him in a plaster helmet and when that was removed he would immediately lapse into a paralysis of speech, a paralysis of one or both limbs and of the bladder and rectum. I repeatedly induced these phenomena; that is, when the cast was removed or replaced for investigation this patient had an incontinence of his urine. We had to catheterize him. He always had an incontinence, which was always relieved on the replacement of the cast. By making traction on his neck and chin, even if he could not speak to us, he immediately would begin to talk and move his arm, and on the removal of the pressure of the fragments of bone on the cord he could move his limbs and void his urine.

Dr. Leo Buerger, New York: I readily appreciate that the phenomena of urination are developing into an understandable quantity. If I understood Dr. Smith correctly he said that injuries to the spinal cord above the lumbar region seemingly had no effect on urination. Dr. Quinby said that a

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fracture of the spine had caused incontinence and other phenomena. Now, the bladder is developed from the rectum; it is a part of the same tissue. If that be true about this etiologic factor neurologically that the spinal cord does not necessarily control urination, it would bring it down to the view that it must be either due to the sympathetic or to the vasoconstrictors or the vasodilators—the vasomotor system. This becomes very interesting, because from the vasomotor system we might have any sort of a condition producing urinary symptomatology.

I had a man who had not been able to pass his urine and every sort of an examination had been made on him. He was a man of importance in his neighborhood. He could not urinate, and there was no known reason. He was the father of healthy children. He was a very healthy appearing man and came from healthy antecedents. I played with him for about six months. At the end of that time he was riding one day in his automobile, the chauffeur was intoxicated, there was an accident in which the patient's back was injured, and he has been able to urinate ever since.

Dr. Martin Krotoszyner, San Francisco: In every otherwise not explainable bladder lesion of functional character the urologist always must be on the lookout for the possibility of an underlying etiologic factor in the cerebrospinal center, the insidious onset of which may first manifest itself by bladder symptoms. A great many of these conditions are either diagnosed too late for adequate specific treatment, or, especially when occurring in men of the age of prostatism, are diagnosed and treated as lesions due to mechanical obstruction. The solution of that problem, to my mind, does not depend so much on competent neurologic counsel, which often is obtained when nerve centers are irreparably damaged, but rather lies in the acquisition on the part of the urologist of a better knowledge of neurologic diagnostic methods as the only means of establishing an early diagnosis.

Dr. William F. Braasch, Rochester, Minn.: The value of cystoscopic data in the early diagnosis of neurologic conditions is not generally appreciated among neurologists. The cooperation of the urologist and the neurologist is often very necessary. Whenever there is any doubt as to whether or not a patient has a central nerve lesion he should be referred to a competent urologist for cystoscopic data. In a high percentage of the cases such data are of great practical value to the neurologist. The well-known changes in the bladder following cord lesions are of two types, namely, trabeculation and dilatation of the internal sphincter. The dilatation of the internal sphincter takes place, in the majority of cases, in the later stages of nerve lesions. The first change is trabeculation, which, as you know, with a cord lesion is quite typical of a large percentage of cases. The trabeculae

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appear ridge-like and are confined largely to the upper portion of the bladder. Without any nerve lesion, however, patients are frequently seen with irritable bladders which on cystoscopic examination appear trabeculated similarly to nerve lesions. We cannot always, therefore, depend on the cystoscopic picture, particularly in the early stages of nerve lesion.

Dr. Edward L. Keyes, Jr., New York: One diagnostic point has been of so much value to me that I venture to bring it to the attention of this assembly. I have in only one case known a tabetic with bladder paralysis to show active ankle jerks, though a number of patients have shown normal knee jerks. Therefore, it seems wise to examine all of our prostatics for ankle jerk. There are cases in which we cannot elicit the ankle jerk and in which there is no cord lesion; nevertheless the absence of the ankle jerk will frequently put us on the right track. In one instance I remember particularly, while the neurologist was in the ward examining the man a laboratory report on the spinal fluid came in. The neurologist said that although the patient had absent ankle jerks and had loss of deep muscle sense in his calves, nevertheless he had no spine lesion. Whereupon the report was read showing characteristic tabetic changes in the spinal fluid.

Dr. Charles W. Bethune, Buffalo: There is another sign which I have frequently observed in tabetic bladders; that is, a gaping of the ureter due to paralysis. Sometimes if one can turn the cystoscope in the right direction one can see a quarter to half an inch up the ureter. If a ureter catheter is introduced through the cystoscope in tabes the patient is unable to feel contact at any point within the bladder.

Dr. Winfield Ayers, New York: I believe we can make one of the earliest diagnoses of beginning tabes in any form by examining the bladder. I recall the last case that came under my observation. The patient had been under a first-class man in New York, who had been treating him with bladder lavage for about a year. On my first observation I immediately asked him if he had had syphilis. He said he had. I tested him for the lesions commonly shown as tabetic, for instance, the pupil, knee jerk, etc. The pupil reacted perfectly, the knee jerk was increased, the ankle jerk was increased. I had a Wassermann made and it was four plus. The only symptom the patient had was a twitching. In washing his bladder his legs would twitch. I put him on a course of sodium cacodylate and all of his bladder symptoms disappeared. His jerk has not disappeared, but he is beginning to have a loss of contraction of the pupils to light, and that seems to me to indicate that he came to me in the pretabetic stage. I think that by seeing these patients early, recognizing them at once from the bladder, the possibly

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severer effects of tabes may be blocked off. I have not had so much experience in the other forms, but in the cases of fracture of the spine that I have seen, in almost every instance they followed out the symptoms described here.

Dr. G. G. Smith, Boston: The record in the paper of nerve lesions is very incomplete, I realize, and yet I felt from my comparatively slight study of the situation that I had learned several valuable lessons. There are a number of nervous diseases causing bladder symptoms which must be diagnosed by a consideration of something more in a patient's condition than the mere examination of knee jerks, pupils and Romberg. Unless one is quite familiar with the symptomatology of some of these nervous diseases, one is likely to overlook them. There is no reason why the urologist should not know these things, but most of us do not. I know I was entirely ignorant of the symptoms of multiple sclerosis, and I had to look up the description of syringomyelia before I knew what that was.

I think the diagnosis of nerve lesions with the cystoscope is difficult, because, as Dr. Braasch pointed out, the bladder manifestations are necessarily limited; we have practically only three things: first, hyperesthesia; second, retention; third, relaxation of the sphincter, with perhaps dribbling. Dribbling may be caused by any one of a number of different nerve lesions, and these different nerve lesions are not always easy to reconcile with the pathology of the disease.

Dr. Geraghty spoke of unexplained bladder disturbances and said that they might be caused by a peripheral neuritis. I would simply say in connection with that that I did have one such case, one of postdiphtheritic paralysis, in which a postmortem examination of the spinal cord was not made, but in which apparently a peripheral neuritis limited to the bladder was the thing that was causing the symptoms.

In regard to Dr. Buerger's remark that I had said injuries above the lumbar cord did not cause symptoms, I think he did not quite understand what I said. I said that injuries of the cord above the lumbar region would allow the reflex to go on, but if the lower centers were cut off from the brain the patient would not be able to stop the act of urination. It is a fact, however, that complete section of the cord is followed by retention of urine at first, although theoretically it should have no effect on the act of urination.

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VESICAL DIVERTICULUM

REPORT OF TWO CASES, WITH REMARKS ON OPERATIVE TECHNIC

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Vesical diverticula represent exaggerated sacculations of the mucous membrane, connected with the general bladder cavity by an opening of variable size. Some writers have expressed the belief that practically all cases are congenital, but latterly there has been a reaction from this position, with a tendency to ascribe most cases to acquired conditions (Lower[1]), the result of obstruction located mainly at the vesical neck.

In the two cases reported herewith the causative relation between obstruction at the vesical neck and the diverticula was plainly shown in the well defined ring of fibrous tissue that surrounded the neck of each bladder; while in the few other cases observed by us, but without being brought to operation, an obstruction was always demonstrable, so that our own inclination is to share belief in the predominance of acquired over the congenital origin of this malady.

Englisch[2] based a differentiation between congenital and acquired diverticula on the question as to whether their walls possessed muscular bands or not, asserting that those with muscular tissue were congenital; those without were acquired.

1. Lower, W. E.: Diverticula of the Urinary Bladder, The Journal A. M. A., Dec. 5, 1914, p. 2015; Cleveland Med. Jour., January, 1914.
2. Englisch: Arch. f. klin. Chir., 1904, 73, 1.

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This classification, however, has been difficult of proof and has not been supported by all writers. Thomas,[3] in reviewing twenty cases of diverticulum observed in the Mayo Clinic, asserts that they were incapable of making such a classification. But whether congenital or acquired, it is probable that some obstruction has been present at some time in every case, either during intra-uterine life or subsequently.

Rokitansky's[4] declaration that diverticula were found only in bladders having hypertrophied walls was not borne out by the two cases herewith reported. In one the bladder wall was as thin as paper and broke down precipitately under gentle manipulation.

Diverticula are single or multiple, and vary considerably in their size as compared with the bladder cavity. Sometimes they are as large as, or even larger than, the bladder cavity.

Whether congenital or acquired, the walls of diverticula are supplied with so little muscular structure that they are inert and incapable of contributing to the evacuation of the organ. Urine contained in them tends to stagnate and undergo infection and decomposition, becoming then highly irritating and a frequent source of urinary sepsis, with chills, fever and other sequels.

No form of treatment has been able to supply this deficiency of muscular activity or contractility to the sacculation and hence, until a definite plan for their removal was finally evolved, operative treatment was a failure. Dilating or incising their orifice, for increasing the ease of communication between the main cavity and the accessory one, failed for the same reason.

Marked developments in respect to both diagnosis and treatment within the past half-dozen years have inspired the greatly added interest, as well as the more frequent recognition of this very imposing and portentous malady. Previous to 1912, although rec-

3. Thomas: Surg., Gynec. and Obst., October, 1916.
4. Rokitansky: Manual of Pathological Anatomy, 1855, 3, 48.

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ognized in the abstract, vesical diverticulum was looked on in the light of a surgical curiosity, rather than a pathologic condition subject to remedial measures. Since then conditions have materially changed, and many persons the subject of diverticula and their attendant evils have been reclaimed from a very miserable existence to comfortable living. This satisfactory development has been due to progress in the technic of diagnosis and of operative therapy.

In addition to wider recognition of diverticula through the better and more universal practice of cystoscopy latterly in vogue, the taking of roentgenograms of the suspected bladder filled with a fluid opaque to the roentgen ray has proved a wonderful service. This has permitted ready identification of the sacculation, its location, size and number, if multiple, and has afforded evidence on which to base a conclusion as to the advisability and mode of surgical attack.

But more important still has been the simplifying of the surgical operative procedure by adopting measures to convert the more or less elusive and intangible diverticulum into a solid tumor by inserting into it the rubber elastic bag of Lerche,[5] or packing the sack with strips of gauze, as suggested by Cabot[6] and popularized by Lower in his several very valuable contributions on the subject. This feature of the technic has proved so valuable that much of the advance in this work must be ascribed to it.

The ureter, occasionally injured or severed during the operation, has been protected or repaired, as the case might be, by measures promoting that objective, such as preliminary ureteral catheterization, as advised by Beer, or the use of valve-flap transplantation, as suggested by Young.

Experience has proved the propriety of keeping the operation extraperitoneal, stripping the peritoneal membrane from the bladder wall as far as necessary

5. Lerche: Ann. Surg., 1912, 55, 285.
6. Cabot: Am. Assn. Gen.-Urin. Surgeons, 1912.

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to give access to the sac; and of sewing up the bladder wall tightly, using a retained catheter in the urethra for urinary drainage. It has been the habit of operators to drain the pocket from which the diverticulum has been removed by a rubber tube or cigaret drain passed through the abdominal wound that was made to gain access to the bladder; but we have used with entire satisfaction, and it is believed with distinct advantage, a stab-wound cigaret drain into the extraperitoneal space, thus avoiding contact with the main wound edges and promoting their early and complete union.

The indwelling urethral catheter is preferred by us over the method of repeated catheterization for emptying the bladder following the operation. There are few patients who cannot easily and comfortably wear a soft rubber catheter for this purpose for the few days required to secure union of the wound area, notwithstanding a widely prevalent impression to the contrary. Many patients can wear urethral catheters for weeks or months, without serious discomfort.

This measure is often one of the most efficient for preparing the patient for operation, affording gratifying if temporary relief from retention and sepsis, and contributing much to the restoration of functional activity to the organs most involved.

It goes without saying that all preparatory measures now recognized as essential to the attainment of success in major genito-urinary operations should be provided.

The steps of diverticulum resection as carried out by us are as follows:

1. The ureter of the affected side is catheterized, the bladder being left filled with fluid and a rubber catheter in the bladder.
2. Epicystotomy is done, the bladder wall being attached to the abdominal wall on each side, but especially on the side opposite the diverticulum.
3. The diverticulum is packed with gauze.
4. The peritoneum is stripped off.

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5. If the ureter has been cut, its end is opened and it is drawn through a button-hole into the bladder and attached.

6. The hole in the bladder wall from which the diverticulum was excised is sewed up. The stitches are reinforced, chromic catgut being employed.

7. Operation is performed on the prostate or neck of the bladder if necessary.

8. Stab wound drainage is used, with a cigaret drain.

9. The retained urethral catheter is inserted.

10. The anterior wall of the bladder is sutured and closed completely, with catgut.

11. The abdominal wound is sutured with catgut and silk-worm gut.

The clinical pictures, as well as the method of securing permanent relief, are fairly well illustrated in the histories of two cases herewith reported.

REPORT OF CASES

CASE 1.—A man, aged 51, railroad engineer, American, married, had no history of any venereal diseases. The patient's health had been good up to the beginning of the present illness, which occurred Nov. 4, 1916. Up to this time he had been in the habit of urinating only four or five times daily and did not void at night. November 4, without recognizable cause, he began to have severe burning with urination and undue frequency. There was no blood in the urine at that time, but with a continuance of the irritative symptoms he noticed that blood appeared ten days later (about November 14). The blood was mixed with the urine and did not precede or follow the act. With remissions there was a continuation of these symptoms until his arrival at the Frisco Hospital, in the service of Dr. G. W. Cale, Nov. 25, 1916. His general condition then seemed very poor; he was thin and looked run down. There was excessive frequency of urination day and night, together with much pain each time; both urines were cloudy with pus and blood appearing microscopically. There was colon bacillus infection. Cystoscopy, November 29, showed widely diffused cystitis of marked intensity. The well defined orifice of a diverticulum was located in the left posterolateral segment of the bladder, anterior (distal) to the ureteral ridge. The orifice appeared about the size of a dime. The bottom of the diverticulum was not visible. The ureter catheter inserted into it reappeared at the orifice after 3 or 4 inches of catheter were used. No stone was observed. The ureteral orifice was not visible on this side. Roentgenograms of the bladder filled with thorium solution showed a definite sacculation about the size of an apple, posteriorly and to the left of the bladder, attached to it by a narrow neck.

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Operation was performed Dec. 9, 1916, with the assistance of Drs. Moore, Woolsey and Smith. Anesthesia was given by Dr. Wood. This operation followed ten days after preparatory treatment, consisting of frequent irrigations through a retained catheter, rest, internal antisepsis, etc. With the bladder fairly well filled and the patient in the semi-Trendelenberg posture, an incision was made in the midline of the abdomen until the anterior wall of the bladder was reached. The peritoneum was stripped from the bladder, partly by a dissection with scissors but more by the gauze-covered finger. It was noticed that the whole anterior wall of the bladder, particularly toward the left, was very thin, at some parts as thin as paper; which explained the fact that when an attempt was made to place stay-sutures in the anterior wall, the wall suddenly broke down and opened up the bladder cavity. After the field had been dried, several catgut sutures were placed in the right wall of the bladder, attaching it to the abdominal wall on that side. The left wall was controlled by a stay-suture left loose and was serviceable later as a guide. Inspection revealed a spacious bladder cavity with ureteral openings plainly visible; and slightly anterior to the left ureteral opening could be seen the orifice of the diverticulum, corresponding to the observation made by cystoscopy. Narrow strips of gauze were then stuffed into the diverticulum until it was quite full. This maneuver was facilitated by grasping the margins of the orifice with forceps and holding them well up, thus permitting a much larger quantity of gauze to be inserted than would otherwise have been the case. The diverticulum was in this way converted into a solid tumor about the size of a pear, outside of the bladder. The peritoneum was then stripped from the left bladder wall and from the tumor. The earlier part of this maneuver was easy, but became more difficult later, as the diverticulum was situated so low down in the pelvis and behind the bladder that it became less accessible. Part of the separation had to be made with scissors. The pedicle was found to be as thick as a finger. With one forefinger through this neck for guidance it was excised with scissors after the tumor had been well lifted out of the cavity. Hot moist gauze controlled the rather rapid oozing of blood into the pocket from which the tumor had been removed. Before closing the bladder it was observed that a dense, fibrous ring surrounded the neck of the bladder and presented positive and marked obstruction to the outflow of the urine. This ring was strongly dilated with a uterine dilator until it presented no further obstruction. Evidently this had had a marked bearing on the development of the diverticulum. The wound in the bladder wall was closed with several layers of chromatized catgut; reinforced until the closure seemed satisfactory.

At this point effort was made again to identify the left ureteral orifice which had been disturbed by the operative

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manipulations, but it could not be identified. However, no leakage of urine could be seen outside of the bladder on that side and the discharge of the urine into the bladder seemed regular. From this observation it appeared highly desirable to catheterize the ureter of the side involved previous to beginning the operation so that it might be identified at any step. This was carried out with complete satisfaction at another, subsequent operation. The anterior wound of access through the bladder wall was closed tightly with a continuous chain-stitch of catgut, without drainage. Two cigaret drains of large size were placed in the pocket to the left of the bladder and were brought out of a stab wound in the left inguinal region, serving the good purpose of providing ample drainage without interfering with the union of the abdominal wound. The muscles of the abdominal wound were united with catgut; skin with silkworm-gut without drainage. A retention catheter, size 20 French, was left in the urethra. Considerable drainage of bloody serum and urine escaped from the stab wound in the next two or three days, due largely to the fact that the catheter became slightly displaced, but on replacing it and applying the Bremerman suction drainage apparatus this impediment was relieved and the operative field remained dry thereafter. No bleeding nor any objectionable symptoms occurred. The only rise in temperature at any time was on the third day, when it was 100 F.; the remainder of the time it was normal. No drainage occurred from the wound after the fifth day; primary union occurred throughout. In a week the patient was able to urinate voluntarily, completely emptying the bladder.

December 15 (the sixth postoperative day), the wound was dry, all sutures were removed and urination was normal and not attended with residuum. No measures were necessary thereafter.

Case 2.—An American manufacturer, aged 39, at the time of his first visit, July 21, 1913, was referred by Dr. J. T. Barbee. The earliest memories of childhood of the patient were connected with slow, difficult, prolonged urination, frequently repeated. He was never able to urinate promptly and satisfactorily as compared with other children of his acquaintance. This difficulty persisted throughout his younger life, and about fifteen years ago there was an increase in the various symptoms, including painful urination, infection, intense clouding of the urine, constant desire, etc. There had been no bloody urine that the patient had noted except after using the catheter, which he had begun about a month previously and had used daily since. The white sediment in the urine he had noticed for the previous ten years. He had found a glassful of urine left over after each effort of voluntary urination. His general health had been poor; he has always been thin and anemic. There was never a definite investigation of his condition prior to March, 1913. At that time Dr. Barbee

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examined and recognized obstruction at the vesical neck and prescribed irrigations to relieve the infection, together with the use of sounds. This produced only partial success so that the patient was referred to us, July 21, 1913. Neither palpation by rectum nor cystoscopy disclosed any evidence of prostatic enlargement or outgrowth. On the contrary, the prostate seemed unduly small. There was, however, a large, relaxed, atonic bladder holding from 25 to 35 ounces of urine without difficulty; and through the cystoscope was observed at this time the opening of a diverticulum located in the posterior wall of the bladder, low down. Although no especial resistance to the dilator was encountered on the introduction of this instrument, the above evidence, together with the history, led to the conclusion that there was contracture at the vesical neck and a diverticulum connected with the bladder was noted. Both ureters were catheterized, and healthy urine was drawn from each.

At this time the operative technic for diverticula had not been worked out to the degree of satisfaction since attained, so that it was concluded to omit operative measures on it and apply those for the purpose of removing the obstruction at the neck. At this time the usual quantity of residual urine following voluntary urination was about 28 ounces. Progressively increasing dilation of the neck by means of the Kollmann dilator improved the patient's ability to urinate and reduced the quantity of residuum to about 8 ounces within a month. It did not relieve the infection or relieve him from the recurrence of septic urinary chills and fever that had been one of his most disagreeable symptoms. After a period of this form of treatments given at home the patient returned, Jan. 13, 1914, and was found again to have 20 ounces residuum. Then a perineal urethrotomy was made; a finger introduced through the perineal wound revealed a definite ring of fibrous tissue that surrounded the neck of the bladder and made positive resistance. This was at first stretched widely with the uterine dilator; but being still appreciable it was incised with the probe-pointed bistoury until free access was obtained. Drainage by means of a urethral catheter was secured.

Great improvement ensued, but still there was a tendency later to recurrence, which was treated with dilatings. The residuum was then reduced to 2 or 3 ounces, less than ever before. After the patient went home the dilatings were continued even up to 45 F., but the benefit was not maintained. Frequent chills and fever and other manifestations of urinary sepsis recurred, and the patient's health continued below par so that when he returned in January, 1917, we concluded it best to go at once to the removal of the diverticulum, which was then believed to be the cause of the continued disturbance.

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Cystoscopy again confirmed the presence of the diverticulum, the orifice of which seemed to be even larger than it had been in former years. The operation was done, Jan. 20, 1917; ether was administered by Dr. Clapsaddle; Drs. Moore and Woolsey assisted. The same method as in the case previously reported was carried out. About ten yards of gauze in strips was packed into the diverticulum, the peritoneum was stripped from the bladder diverticulum, the latter being very inconveniently located under the base of the bladder. This, however, did not prevent its enucleation, after which it was resected. The opening was sutured tightly with chromic catgut. Before closure of the anterior vesical wound, the fibrous tissue surrounding the neck of the bladder was again demonstrated with the finger, though it was not nearly so tight as formerly. It was widely stretched with the uterine dilator until it offered no further resistance. The bladder wound was then sewed; a stab wound to the left of the bladder was made for draining the cavity from which the diverticulum had been removed. The bladder wound and abdominal wound were closed without drainage.

Following the operation there was scarcely any bleeding; there was good drainage and no systemic reaction. January 25, the patient was in excellent condition. There had been only a small amount of drainage from the stab-wound. The cigaret drain was then removed. The retained catheter was removed from the urethra, January 31, and the patient's ability to urinate freely and to empty the bladder completely was then demonstrated. The patient could not remember ever having been able to urinate with such completeness and satisfaction. This practically completed convalescence, and he went home in good condition.

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THE RESULTS OF TREATMENT OF BLADDER TUMORS *

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The treatment of bladder tumors prior to 1910 was in almost all cases a surgical one, with an attempt at partial or complete removal of the growth. Whether the tumor was benign or malignant, operative procedure offered the only hope of cure or alleviation. The brilliant results obtained by Nitze in his endovesical treatment of bladder tumors were not duplicated by other urologists, as the skill necessary for the employment of his methods was not perfected. The introduction of fulguration by Beer and later the employment of radium are two procedures which have served radically to change our ideas, and have consequently affected our attitude in the selection of the proper treatment for any individual case.

When fulguration was first employed, the results obtained by different surgeons were apparently immeasurably superior to the results secured by old operative methods. It began gradually to be realized, however, that all vesical tumors were not amenable to this form of treatment, and that while certain tumors disappeared with surprising rapidity, others responded only after long and vigorous applications, while others again were not affected in the slightest degree.

In order to secure an explanation of the difference in the response to treatment, we have made a study of the pathology of the different tumors and tried to correlate the different types and their response or

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resistance to fulguration. The results of this study have shown that the tumors which respond most readily to fulguration belong to the benign papilloma type, while those which are not affected, or are often stimulated in their growth, are histologically papillary carcinoma. There is, however, an intermediate group of tumors, the malignant papilloma, which varies in its response to this treatment, some responding almost as readily as the purely benign type, while others approach in their resistance the true papillary carcinoma. The differentiation between the malignant papilloma and the papillary carcinoma may, in many cases, be extremely difficult, and, notwithstanding the histologic picture, the final diagnosis may be reached purely by the response to fulguration or radium. The employment of radium within the last few years has necessitated still further studies regarding the type of tumor in which this agent has proved valuable. As with fulguration, it has been learned by experience that certain tumors disappear under its influence, while others apparently are not affected by it.

Much confusion has always existed concerning the nature and pathology of bladder tumors. Most of this confusion exists as regards the papillary tumors which are the commonest of vesical neoplasms. Until a definite classification is adopted and a specific nomenclature employed, these inaccuracies will continue. For example, the use of the term "cancer" for the papillomatous, noninfiltrating types of tumor, even though there be histologically malignant changes present in the epithelium, is confusing, because experience has shown definitely that certain therapeutic measures suitable for one are wholly inadequate for the other. Frequently the surgeon in reporting the results of a given form of treatment for cancer may include in his series cases of malignant papilloma. The result of such a report leads to erroneous conclusions. A classification which has proved at least a satisfactory working basis is the following, because it is possible

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to correlate the histologic and clinical picture with the response to different therapeutic agents.

The papillary tumors may be classified as benign papilloma, malignant papilloma and papillary carcinoma. Papilloma is a name which common usage has popularized in medical literature, and it is used to denote a group of tumors having certain gross characteristics. The term "papilloma" has come to imply a pedunculated, papillary form of villous tumor springing from the mucous membrane of the bladder and being essentially composed of a branching connective tissue framework, lined by epithelium in several or many layers. Statistics prove conclusively that papilloma is by far the most frequent tumor of the bladder, and when it is further considered that practically all the papillary carcinomas represent an advanced malignant degeneration of tumors which in their early stages were papillomas, the preponderance of this type of vesical neoplasm can be appreciated.

The gross appearance of papillomas varies considerably, and there is no definite characteristic which will differentiate the benign from the malignant. In most instances it is impossible from the gross appearance to decide the character of the growth, so closely in general appearance do the benign and malignant papillomas resemble each other. The pedicle in the malignant papilloma is freely movable over the underlying mucosa, and there may be nothing in its appearance to reveal its malignant character. In the vast majority of cases, the differentiation between the benign and malignant papillomas can be made only by the most careful microscopic study, and it sometimes necessitates the examination of sections from various portions of the tumor. In the benign papilloma, the connective tissue axis is lined by an epithelium which has a palisade arrangement at the base and above this many layers of oval longtailed cells which are uniform in size, shape and staining characteristics. Toward the surface the cells become flattened, and the most

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superficial are similar to the epithelium of the normal bladder mucosa. In the malignant, the arrangement of the epithelium is changed, and instead of being in regular, uniform layers, it is disordered. The individual cells are very irregular in size and shape, and take the stain with varying degrees of intensity. These variations from normal are even more evident in the nuclei. At times, owing to the lawless growth of the epithelium, the papillae fuse so that the regular papillary arrangement is destroyed. Not infrequently in the same field, papillae may be seen undergoing various degrees of alteration. In one portion the epithelium may have all the characteristics of the benign papilloma, but close by may be papillae in which epithelial changes characteristic of malignant papilloma are very evident.

The term "malignant papilloma" should be reserved for those tumors in which the malignant changes are confined to the epithelium, and in which there is no infiltration of the epithelium into the connective tissue framework. When the epithelium breaks through its basement membrane and begins to invade the axis of the papilla or its main stalk, it no longer should be considered a papilloma, but a papillary carcinoma.

In order to arrive at some conclusion as to what may be expected from the different forms of treatment, we have included in our studies only those cases which have been seen since January, 1911. This makes it possible to compare our results of the last six years in which recent procedures have been employed with the results obtained prior to this time when operative measures alone were used. From Jan. 1, 1911, at which time fulguration began to be employed for the first time in our clinic, until April 1, 1917, 145 cases of bladder tumor have been observed. Of these there were 64 cases of papilloma, 74 of papillary carcinoma, 3 of adenocarcinoma, 1 of colloid carcinoma, 1 of cystic adenoma and 2 of multiple vesical polyps.

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THE TREATMENT OF PAPILLOMAS

Of the sixty-five cases of papilloma in our series, thirty-four were treated by fulguration alone, the Oudin or unipolar current being almost exclusively used. In five of these, previous suprapubic excision had been performed and the tumors represented recurrences. In twenty-six of the thirty-four cases treated by fulguration, subsequent cystoscopic examinations were carried out, and in ten cases, or 29 per cent., recurrences were noted. In seven cases the recurrence was present in less than one year, in one case after one year, in one case after one and one-half years and in one case after two years. In three of these cases the recurrence was in the region of the original tumor, and in the remaining seven they were on portions of the bladder wall distant from the site of the primary tumor. Of the sixteen cases in which there was no recurrence, one patient was well for six years, one for five years, one for four years, three patients for three years, three for two years, two for one year and five for less than one year.

The recurrent tumors, with one exception, have all responded to fulguration like the original tumor. This one exception is of extreme interest.

CASE 1.—This patient had a papilloma several centimeters in diameter just back of the ureteral orifice, which disappeared rapidly under fulguration. For several months after the disappearance of the tumor, the mucous membrane in the tumor-bearing area appeared perfectly healthy. Shortly after, cystoscopy revealed a peculiar reddening and slight bulging of the mucous membrane in this region without ulceration or definite tumor formation. At first this was thought to be a localized inflammatory area. The process, however, seemed to spread, and a piece removed by the cystoscopic rongeur revealed an infiltrating carcinoma with the mucosa covering it practically intact. This is undoubtedly a case in which cancer cells from the malignant papilloma had metastasized into the deep bladder wall and there continued to grow after the original tumor had completely disappeared. This case really should be considered as a metastasis rather than a recurrence.

One other case is deserving of special mention because the recurrences continued over so long a period.

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CASE 2.—This patient, aged 52, was seen in February, 1912, with a large papillomatous tumor covering the left lateral wall and with several smaller tumors around the vesical orifice. The small tumors readily disappeared, but the large tumor responded only after months of vigorous and intense fulguration. Within a few months after the last vestige of the original tumor had disappeared, several recurrences the size of a pinhead were seen in widely separated portions of the bladder. These responded readily to fulguration. Since then the patient has been examined with the cystoscope on an average of about once a month, and practically at every examination small papillomas are found. During the last five years, probably several hundred tumors have been removed in this way. At the present time, the tendency to recurrence is just as active as it was five years ago, but it has been possible by watchful and persistent care to destroy the recurrence as fast as they form.

Treatment by Radium and Fulguration.—During the past two years, for papillomatous tumors which have shown histologic changes characteristic of the malignant papilloma or which were unusually resistant to fulguration, radium has been employed in combination with fulguration. Depending on the size of the tumor, varying amounts of radium have been employed, ranging from 200 to 1,000 milligram hours. Of the eighteen cases treated by this combination, in seven the tumors were multiple. Two patients discontinued treatment before the tumors had been removed. In the remaining sixteen cases, the tumors were completely destroyed. In all but one of these, subsequent cystoscopic examinations have been made, and in four cases, or 27 per cent., recurrences were found. In all four cases the recurrences were present in less than one year. The remaining eleven cases were free from recurrence for periods of time as follows: three for two years, four for one year, three for six months, and one for three months.

The following case illustrates the specific rôle which radium seems to play in rendering malignant papillomas, which have proved resistant to fulguration, amenable to this form of treatment.

CASE 3.—A man, aged 75, had a papillomatous tumor 3 cm. in diameter just back of the trigon. Cystoscopically the tumor was pedunculated, with short stubby papillae. Microscopic

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examination of a piece of tissue removed showed the characteristic changes of malignant papilloma. The tumor was apparently in no way different, either cystoscopically or microscopically, from other tumors in which fulguration is effective. The tumor was fulgurated over a period of six months at biweekly intervals, and at the end of this time it was about three-fourths its original size. In the beginning of the treatment, the tumor decreased definitely but slowly, and finally it seemed to remain stationary in size. Frequently a fulguration sufficiently vigorous to coagulate apparently the entire tumor mass was employed, but examination two weeks later, on the separation of the slough, would reveal the tumor apparently unchanged. Finally radium was applied directly to the surface of the tumor, both the beta and gamma rays being employed. These radiations totaled 600 milligram-hours and were carried out over a period of eight weeks, 103 mg. of radium being applied for one hour at approximately weekly intervals. At the conclusion of this radiation, the tumor showed no evident changes either in size or appearance. The tumor was now vigorously fulgurated, and disappeared completely after one treatment. The patient died six months later of pneumonia. Necropsy revealed no recurrence in the bladder and there were no metastases present.

Up to the present time there have been six other cases responding only slightly to fulguration which, after varying amounts of radium, have yielded readily to the high-frequency treatment. All of these cases were of the malignant papilloma type.

Another case of considerable interest is the following:

Case 4.—A man, aged 50, had two papillomatous masses on the anterior bladder wall which had received a large amount of fulguration elsewhere without any apparent improvement. The resistance to this type of treatment was confirmed by us. A course of radium was then employed which was followed subsequently by fulguration, the tumors apparently disappearing promptly. Cystoscopy one month later revealed a recurrence in the same area. This was treated in a manner similar to the other tumors, with disappearance. There was noted on cystoscopy after the disappearance of the tumor, in the region formerly occupied by it, a small shallow cuplike depression in the bladder wall, resembling a cellule. Examination three months later revealed another recurrence. The tumor occupied so ideal a position for resection that operation was decided on. When the bladder was exposed, a diverticulum was found at the point of the insertion of the urachus. This was filled with tumor, which readily explained the recurrences. The diverticulum communicated with the bladder by a narrow

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orifice and the tumors previously destroyed were implantations of the tumor concealed in the diverticulum.

Treatment with Radium.—In three cases the papillomas were treated with radium alone, and in all three cases the tumors treated disappeared under the influence of radium. One of these cases is of particular interest in that the patient had numerous malignant papillomas around the vesical orifice and a localized infiltrating papillary carcinoma involving the right ureteral orifice. Any operative procedure, short of complete cystectomy and prostatectomy, would have been useless. It was possible, however, to destroy the papillomas by means of radium within a few weeks, after which a resection of the papillary carcinoma, with transplantation of the ureter, was successfully carried out. The papillary carcinoma and other forms of infiltrating malignant tumor, in our experience, as will be considered later, have not responded to this form of treatment, and resection was consequently indicated. This case probably illustrates very well the possibilities of a combination of treatments for securing results practically impossible of attainment by any one procedure.

Technic of Radium Applications.—In this connection it may be well to outline briefly the technic we have followed in the application of radium to bladder tumors. The treatment in practically all cases has been carried out with 103.7 mg. of radium element. In the majority of the treatments a fenestrated brass capsule has been employed and both the beta and gamma rays utilized. In other cases, however, the radium has been contained in a capsule of platinum 1.5 mm. in thickness, a screenage sufficient to filter out practically all of the irritating beta rays. The capsule containing the radium had been introduced into the bladder in the beak of an instrument not unlike the sheath of the irrigating cystoscope. These instruments permit the passage through them of an

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observation cystoscope by means of which the tumor may be viewed and the radium accurately placed on it. After the radium has been directed against the tumor, the instrument is held in a fixed position by means of a mechanical arm attached to the cystoscopic table. The radiations are usually given throughout the period of an hour at each seance and carried out from one to three times weekly, depending on the tumor and the reaction of the patient to the treatment.

Treatment by Suprapubic Removal.—This procedure was carried out in ten cases. In six of them the tumors were removed by the actual cautery and in four by resection. Of the former there were two recurrences in less than one year, while in the latter no recurrences were noted. It should be stated that in both cases in which recurrences were found the tumors were very extensive and occupied a large portion of the bladder wall. Of the patients treated by removal with the cautery, one has been well six years; one, two years; one, one year, and one for six months. Of those resected, three have been well five years, and one, one year.

PAPILLARY CARCINOMA

In eighteen of the seventy-four cases of papillary carcinoma, the tumors were considered operable, and in all of them radical resections were carried out. In five cases the ureter was transplanted, and in one case both ureters were similarly treated. In these eighteen cases there was only one operative mortality, that being the case in which both ureters were transplanted The death in this case occurred in the third week, being due apparently to pulmonary embolism. It has been possible to secure data concerning all of the eighteen patients. Eight have since died, and of the ten living, one has been well for six years, one for five years, one for four years, and seven for less than one year. It is noteworthy that recurrence in the suprapubic scar, which was a not infrequent sequela

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in our earlier operation, has not been observed in any of these cases. This is probably due to the greater care which has been exercised in preventing implantations during operation.

In fifty-six cases, or 75 per cent., the papillary carcinomas were so extensive that radical excision was considered impossible. In eleven of our extensive cases fulguration was employed, but aside from symptomatic relief, nothing was accomplished. In a few instances, it was possible to destroy enough of the tumor to give temporary relief from mechanical obstruction, while in certain of the cases, hemorrhage was relieved. In no instance was it possible completely to destroy the tumor.

Treatment by Radium and Fulguration.—In eleven cases a combination of radium and fulguration was used. The radium in every instance was applied directly against the tumor mass, and varying amounts, from a few hundred to several thousand milligram hours of radiation, were given. In the majority of cases both the beta and gamma rays were employed, but in the remaining the radium was heavily screened with sufficient platinum to filter out practically all of the beta rays. The combination of radium and fulguration of this type of case in no instance caused the complete disappearance of the tumor, or, in fact, any marked effect on it. In some cases, however, some symptomatic relief was obtained.

Treatment with Radium.—In thirteen cases with extensive infiltrating carcinoma, radium alone was employed. The results in this series differ in no respect from the cases treated by the combination of radium and fulguration. As in the latter series, a number of cases were relieved symptomatically, but in no case was there complete disappearance of the tumor.

Diagnosis.—The study of our results strongly emphasizes the necessity of early differentiation of the papilloma from the papillary carcinoma, because the

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endovesical methods at our command have proved to be futile in the treatment of the latter type. On the other hand, these endovesical methods for the treatment of papilloma yield results incomparably superior to any of the more radical procedures. The differentiation of the benign and malignant papilloma, so far as treatment is concerned, is not so essential, for in the majority of the latter variety, fulguration proves most satisfactory. In the small group which proved resistant, the combination of radium and fulguration will accomplish the desired result.

The differentiation between the papillary carcinoma and the malignant papilloma is not always easy, but in the majority of cases cystoscopy, palpation, histologic examination of a portion removed and a consideration of symptoms, either alone or, as is usually the case, in combination, will furnish information sufficient to make an accurate diagnosis.

Cystoscopy.—It is surprising how frequently from cystoscopy alone one is able to distinguish the papilloma from the true carcinoma. While the pedicle of the papilloma is rarely distinctly visible, often the tumor mass can be seen to sway as a whole in the fluid, which indicates its pedunculated character; and at other times it is possible to view slightly beneath the mushroom-like edge of the tumor. It is impossible from the cystoscopic appearance of papillomas to determine whether they are benign or malignant. When, however, the malignant changes are so advanced that infiltration of the bladder wall has occurred, there are certain cystoscopic appearances which nearly always enable one to arrive at a fairly accurate diagnosis. The presence of necrosis in the papillae is indicative of carcinoma, and is usually associated with invasion of the underlying bladder wall. In the earlier stages, when the tumor has just begun to invade the bladder wall, it may not be possible cystoscopically to determine this point; but when

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the process is at all advanced, the tumor loses its pedunculated character and becomes sessile in type. Frequently, around the margin of the tumor is seen edema, or bullae, which are usually indicative of a cancerous invasion of the bladder wall below. At other times little tumor nodules can be seen beyond the main tumor growth. This again is indicative of cancer. While it is impossible definitely to describe all the appearances which serve to diagnosticate the papillary carcinoma from the malignant papilloma, the cystoscopist of experience is usually able to differentiate them, and it is interesting to note how frequently the cystoscopic diagnosis proves to be correct.

Palpation.—Occasionally, when the bladder is extensively involved with an infiltrating form of growth and the abdominal wall is thin and soft, the hard, irregular mass can be detected. When malignant growths occur on the posterior wall of the bladder, or on the posterior lateral wall, rectal examination frequently gives most valuable information regarding the nature of the growth and its extent, and frequently determines the possibility of complete eradication by operative procedures. When the growth infiltrates the bladder wall, induration can be detected, and the extent of the bladder wall involvement can be more or less accurately mapped out. About 50 per cent. of bladder tumors occur on the posterior bladder wall in a position accessible to the examining finger. Sometimes not only the induration is detected in the bladder wall, but later the seminal vesicles are also involved, and still later the prostate. In rare instances, the growth may extend through the rectum and a rectovesical fistula may result. This complication occurred in three cases in our series. It may be safely said that marked induration of the bladder wall, which is felt through the rectum, is strong evidence of carcinoma. In the female, valuable information regarding the condition of the posterior bladder wall may be obtained by vaginal examination.

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EXCISION OF A PIECE OF TUMOR FOR DIAGNOSIS

For a number of years we systematically removed pieces of bladder tumor by means of the Young cystoscopic rongeur for the purpose of histologic examination. The information derived from this method would seem to furnish conclusive evidence of the nature of the tumor, and consequently enable one to select accurately the type of treatment best suited to the tumor in question. Unfortunately, the evidence derived is not always conclusive, because of the fact that the portion removed is not always a safe index of the character of the remainder of the tumor. The piece removed may show no, or very few, malignant changes, while other portions of the tumor may be definitely carcinomatous. When the piece of tumor excised shows, however, definite carcinoma, the employment of radical procedures suitable for the individual case should be adopted without delay, and time should not be lost in the employment of the usual endovesical methods of treatment. The excision of a piece of tissue will also prove of value in differentiating the different types of vesical tumors. It should be noted, however, that the removal of the tissue by this means has been criticized as increasing the risk of metastasis. This has not been our experience, and the information obtained frequently counterbalances the theoretically increased risk of metastasis.

SYMPTOMS

It has also been our experience that when a severe, intractable cystitis is associated with bladder tumor, the tumor has proved practically always to be cancer.

In rare instances, when the cancerous process is very early, it may be impossible to determine this by the usual methods. In these cases it has been our custom to test out, as it were, the nature of the tumor by means of fulguration and radium. If the tumor

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does not show prompt response to this combination, it can be assumed that it is of a cancerous nature.

METASTASIS

When the possibility of metastasis in a given case is considered, it is again important to know the type of vesical tumor concerned. In our series of sixty-four papillomas, 75 per cent. of which were malignant, four cases of metastasis were noted. In all four cases the tumor was a pedunculated papilloma, which in every instance disappeared completely under fulguration alone, or fulguration and radium combined. In one case, evidences of metastasis did not develop for four years after the removal of the primary tumor, but in the interval a great many recurrences had been destroyed.

Of eighteen papillary carcinomas in which the carcinoma was considered sufficiently well localized to attempt resection, and in which it was possible completely to remove the local growth, seven patients have since died of cancer and one of intercurrent disease. Of those living, only three have been well for a period of more than four years. When the carcinoma is extensive and deeply infiltrates the bladder wall, metastases are usually present. It should be recognized, however, that at times most extensive involvement of the bladder may be present with negative findings at necropsy, so far as metastases are concerned. In three of our cases in which the tumor was so extensive that complete removal seemed impossible, and in which death occurred while under observation, no metastases were demonstrated postmortem.

CONCLUSIONS

The results of our experience in the past six years may be thus summarized: It is essential to determine accurately the type of tumor in a given case, in order to select the treatment best suited to the particular type in question. The early recognition of papillary

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carcinoma is most essential, and the diagnosis being made, the tumor should be radically resected, if operable. In our experience fulguration and radium have proved valueless in the cure of this type of tumor.

In this connection, it should be emphasized that, following the complete removal of a papillary carcinoma by resection, a recurrence may develop which in some cases proves to be, in its early stages, a malignant papilloma, and in this stage will respond to fulguration, or to a combination of fulguration and radium. In three of our cases in which a papillary carcinoma was radically removed, recurrences were found later and destroyed, by fulguration in two cases, and by radium and fulguration in the third.

While the results following the use of radium in the infiltrating carcinomas have been disappointing, the response of the more resistant malignant papillomas to this agent has been most encouraging. Radium alone will unquestionably destroy both the malignant and the benign papillomas, and on account of its influence on the former makes possible their cure without the employment of radical procedures which would otherwise be necessary. It has been our custom, when the diagnosis of malignant papilloma had been made, to give a varying amount of radiation, dependent on the size of the tumor, and to follow this by fulguration. Some of our malignant papillomas, in which fulguration was first tried without success, radium has rendered readily responsive to this treatment. Indeed, several cases which have stubbornly resisted frequent and vigorous fulguration, after a course of radiation have responded promptly to this measure.

The development of the endovesical methods has rendered it possible to effect a cure in practically all cases of papillomas, and the employment of the more radical operative methods has not been productive of

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results at all comparable with those following the more conservative methods. With the exception of rare cases, in which an operative procedure is carried out, resection alone should be performed, because operation is indicated only when the tumor is a papillary carcinoma, and mere superficial destruction, as with the cautery, etc., will usually be futile.

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RADIUM TREATMENT OF CARCINOMA OF BLADDER AND PROSTATE

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In estimating the value of radium in the treatment of both carcinoma of the bladder and carcinoma of the prostate, comparison between operative results and radium results is desirable. Yet such a comparison is difficult because of the fact that comparatively few cases have been treated by radium, and the statistics of surgical results, especially in carcinoma of the bladder, are incomplete and often misleading.

CARCINOMA OF THE BLADDER

In a recent paper by Gardner on "Surgical Results in Carcinoma of the Bladder," no distinction is made between operative results in papillary carcinoma and operative results in the indurative type, and this is the crux of the entire matter. Both surgery and radium can often destroy the papillary carcinoma, while both surgery and radium probably have a hard time in getting rid of carcinomas of the indurative type. It is only when we have learned to definitely distinguish between these two that we shall have any adequate idea of the value either of surgery or of radium. Again, radium has been used in comparatively few cases of carcinoma of the bladder; it has been used in extremely few cases which might be called operative. Generally the cases falling to the lot of radium therapy are those in which surgery has failed or is impracticable. There are, however, a number of conditions which should favor a careful considera-

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tion of radium therapy instead of surgery. The first and foremost of these is the fact, taken from the statistics of Gardner, that the initial operative mortality in cancer of the bladder when either the growth alone is removed or a partial cystectomy is done, is between 14 and 27 per cent. This 14 to 27 per cent. is total gain on the side of radium. In thirty-eight cases of carcinoma of the bladder treated by radium we have had no initial radium mortality.

Again in four cases, two extensive papillary and two less extensive indurative carcinomas (three confirmed microscopically as carcinoma) radium has locally removed the growth. One of these has been cystoscopically cured for sixteen months, one for eight months. One had a bladder free of tumor for five months; then was not examined cystoscopically for six months, when he had an extensive recurrence and palpable induration. One has a radium burn on the site of what was thought to be a slight local recurrence. This patient's bladder was free of tumor at the first cystoscopy after radium treatment. These four cases are of sufficient interest to report in some detail.

REPORT OF CASES

CASE 1.—*Signs of Malignancy: Large tumor of papillary type; vaginal induration not determined; sloughy in part; microscopic diagnosis of carcinoma; fulgurated twice, and no headway.*

C. A. G., a woman, aged 69, complained chiefly of urinary frequency for the past year, voiding three to four times at night and every three to four hours during the day, pain following urination, and hematuria was present for the past four months. A number of months before I saw her she was examined by cystoscope, and a diagnosis made of inoperable carcinoma. Cystoscopy revealed a large red carcinoma with necrotic patches on the left side of her bladder obscuring the left ureteral orifice. The tumor was probably as large as a fifty cent piece. The specimen removed revealed (Dr. Ewing) "the structure of a small alveolar carcinoma, much inflamed, with dilated blood vessels. The cells are clear, irregular in size, with large hyperchromatic nuclei, and arranged in small groups. The stroma is scanty."

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Jan. 19, 1916, 100 mc. of screened radium were inserted in the bladder for eight hours.

February 4, she reported some frequency and severe bladder pain for two days; then everything was normal. Cystoscopy (performed with Drs. Keyes and Jeck) revealed that the tumor had gone, the area was covered with normal mucous membrane, and the ureter was visible.

June, 1917, she had a stellate, white scar over the place occupied by the tumor. No tumor was visible. Reduplication of ureter.

CASE 2.—*Signs of Malignancy: Tumor as large as a ten cent piece; no rectal examination; ulcerated tumor; microscopic diagnosis of carcinoma; fulgurated four times in six months and recurred.*

C. T., man, aged 59, eight months before being seen had occasional attacks of painless hematuria. He was examined by cystoscope and a papilloma near the left ureter was seen. This was burned with high frequency four times in about six months, but had always recurred. Dr. Keyes saw it in January, 1916, when it was an ulcerated area with carcinomatous looking lumps. A piece removed revealed diffuse carcinoma. Dr. Ewing gives the following description: "The section presents a small alveolar and diffuse carcinomatous structure. The cells are extremely atypical, and some are of very large size, with very hyperchromatic nuclei. The outer portions are hydropic, the central areas show fibrosis, and here the tumor cells run in narrow rows or small groups."

Feb. 11, 1916, 214 mc. of screened radium were inserted for seven hours.

May 2, cystoscopy revealed normal mucous membrane over the space occupied by the carcinoma.

July, he had gained 10 pounds. Cystoscopy by Dr. Ballenger was negative.

November 8, Dr. Ballenger reported that he "has passed no more blood. Cystoscopy about a month ago showed only a reddened place where the growth was. There has been a rather persistent cystitis."

In May, 1917, the patient was examined cystoscopically and at the site of his original tumor there was a large indurated carcinoma. Rectally was felt an indurated bladder base. This patient went six months with a bladder free of signs of carcinoma. One cannot say whether radium could have done better if applied oftener in this case. It emphasizes the fact that all these patients should be examined frequently.

CASE 3.—*Signs of Malignancy: Extensive tumor; vaginal induration as large as a silver dollar; sloughy in part; microscopic diagnosis of papilloma; no fulguration.*

Mrs. E. H. S., a woman, aged 54, complained chiefly of hematuria for the past year, and urinary frequency at night voiding five to twenty times. Cystoscopy revealed a grapelike, red, partly

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sloughy tumor around the bladder neck. Vaginally there was an indurated area of the base of the bladder, nearly as large as a silver dollar. A specimen removed was reported by Dr. Ewing as being papilloma. Because of the induration, and because of the slough, I considered this carcinoma.

July 6, 116 mc. of radium were inserted in the bladder neck for six hours. Patient reported one month later that she had a little discomfort in passing urine for a few days. She had gained 15 pounds in weight, got up but twice at night to urinate.

August 29 she still had a tumor around the bladder neck. One hundred mc. of radium inserted in the bladder neck for eight hours. She has had no hematuria since the first radium.

Oct. 30, 1916, she reports she had no pain after the radium. Cystoscopy showed the tumor to be gone. She had gained 18 pounds in all. No induration of bladder base. Had no night urinary frequency.

June, 1917, the bladder was free of the tumor.

CASE 4.—*Signs of Malignancy: Tumor as large as a quarter; induration shown by cystoscopy; sloughy; microscopic diagnosis of carcinoma; fulgurated twice, and tumor grown two or three times its original size.*

J. A. H., a man, aged 62, had had two attacks of total hematuria, one month and eight days before seen. There was no night frequency; no loss of weight. Dr. Keyes saw by cystoscopy a red, lobulated, rather flat carcinoma above the right ureter; he burned it with high frequency and advised radium. The patient went to another physician who fulgurated the tumor and decided against both operation and radium. About three months later he returned when (with Dr. Keyes) a flat, sloughy in part, carcinoma was observed, two to three times the original size, extending from the bladder neck to a point 2 cm. above the right ureter. It had raised, thick, indurated edges. A specimen removed (Dr. Ewing) revealed carcinoma. Two tubes of screened radium (one 90 and one 89 mc.) were left in his bladder six hours.

Two months later the patient returned, when there was seen redness of the right side of the bladder, and a small ulcer back of ureter (well away from where the tumor was) probably due to radium burn. *No other lesion was seen.*

Two months later there was a linear ulcer 1 cm. long, surrounded by puckered red mucosa, on the anterior end of his original tumor. It looked like a recurrence, although a piece removed revealed no carcinoma. He was again treated by radium.

Still three months later he showed an extensive white slough over the right side of the bladder which might either be a radium burn or carcinoma. As there was no induration by rectum, it probably was a burn.

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COMMENT

We have had other cases in which papillary carcinomas have been removed in part from the bladder. These cases are too recent to report on. We have had a large number of cases of extensive indurated carcinomas which have shown little or no improvement under radium. Detailed reports of most of these cases have been given and are not necessary here.

Summing up our experience of nearly two years of radium therapy, we believe that radium is to the papillary carcinoma what fulguration is to papilloma.

The indurative type of bladder carcinoma is a different story. They are much more difficult to destroy than papillary carcinoma. If there is any hope of radium therapy, and I believe there is, they must be attacked early and vigorously.

APPLICATION OF RADIUM IN BLADDER CARCINOMA

The technic of the application of radium in bladder carcinoma is as yet far from perfect. To get results a six to eight hour application is necessary. No patient will stand an instrument in his urethra for this time. Suprapubic operation and the application of the radium to the tumor is an unnecessary procedure, and carcinomatous patients, because of their age and the intoxication caused by the carcinoma, do not stand operations well. I do not mean that they die, but they have lowered resistence and complications are prone to happen. Then in doing the suprapubic section we may cut into the carcinoma. These various reasons have determined the following technic:

Two capsules of screened radium (0.6 mm. of silver and 1.5 mm. of rubber) from 50 to 100 mc. are placed in the bladder through the sheath of the cystoscope and allowed to remain there six to eight hours. As 90 per cent. of bladder tumors are on the bladder base, the radium so inserted is in close contact with the tumor. If the carcinoma is on the vault or lateral walls the patient lies on his abdomen or on his side.

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After the treatment the radium is removed per urethra by a linen thread attached to the capsules.

The initial pain experienced is only that of the cystoscopy. The after-burn varies from none at all to more or less severe pain beginning a few days after treatment and lasting from one day to several weeks.

In extensive carcinoma involving the bladder sphincter irradiation may increase both the pain and the urinary frequency. It is to be used in these cases with caution.

EFFECT OF RADIUM ON BLADDER TUMORS

In a large majority of the cases in which I have applied radium to bladder tumors, the hematuria has stopped two or three days after the irradiation. There is a suggestion in this that the primary effect of the radium is on the blood vessels. If this is so it would in a measure explain why papillomas of the bladder, rich in blood vessels, react somewhat more slowly to radium than true carcinomas which have poor and imperfectly developed blood vessels.

In some cases the rapidity of the action of radium is astonishing. Case I was irradiated January 19, and on February 4 (sixteen days later) cystoscopy revealed that an extensive carcinoma had entirely disappeared.

Radium burns of normal portions of the bladder have occurred only in those cases in which the carcinoma was around the bladder neck, and in which the radium was pulled into the urethra and kept there for a long time. I have had two such cases; the burns last a long time, and cause much irritation. Division of the radium dose into two or more tubes, using somewhat smaller quantities; change in the position of the patient during application; and a fairly long interval between irradiations—six weeks or more—ought to prevent such burns.

INDICATIONS FOR THE USE OF RADIUM

This brings us to the question, In what cases are we to use radium? I believe, first, that radium should be

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tried in all those cases in which we have reason to think the carcinoma is confined to the bladder, to see what the radium will do, much as fulguration has been used as a diagnostic test of carcinoma. The second indication is hemorrhage from a bladder carcinoma. One dose of radium seems to pretty consistently check this symptom.

CARCINOMA OF THE PROSTATE

There is apparently unanimity of opinion as to the operative indications, operative and final mortality and complications in operation on carcinoma of the prostate. The immediate operative mortality is probably 25 per cent. or more. The patients living for two or three years[1] after operation are few. If the patient survives an operation performed with the idea of completely removing the carcinoma, he is often left with an incomplete or total incontinence of urine. If an operation is performed with the idea of simply removing obstruction to urination, the patient may, or may not, be able to completely empty his bladder immediately after operation, and I believe is very rarely able to do this six months later, if he survives that long. It is my opinion, based on personal observations, that various operations to remove urinary obstructions in carcinoma of the prostate are singularly inefficient. For these various reasons many, if not most, surgeons agree that operation for carcinoma of the prostate is contraindicated.

From thirty-nine cases of carcinoma of the prostate treated by radium since October, 1915, the following conclusions have been derived:

1. Radium treatment has caused with fair regularity the reduction or disappearance of carcinomatous nodules of the prostate. Striking results have been obtained both in early and advanced cases. The early cases, those in which the carcinoma is fairly well con-

1. This refers solely to patients operated on. Patients not operated on often live longer than this.

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fined to the prostate, and in which there is little or no perivesicular infiltration, show shrinkage of the carcinoma. Few of the advanced cases, those in which there is an enormous prostate and in which the vesicles are hard and indurated, show any improvement.

2. Patients in whom carcinomatous lobes show reduction must be very carefully watched and regularly treated every two or three months if any suspicious prostatic lumps are felt. It is only this constant hammering at the carcinoma which gives any hope of permanent cure.

3. The symptoms in those cases in which the carcinoma had been reduced show striking improvement. This symptomatic improvement is shown in increased weight and strength, decrease in frequency of urination and return of or improvement in erections. One patient of 74 years, on whom a suprapubic exploration revealed carcinoma of the prostate and who was treated but once with radium, gained 8 pounds and reported five months later that he was then "doing a full day's work on steam boilers." He stated on questioning that a full day's work was from 5 a. m. until 11 p. m.

He is still working, one year after his first treatment. He still has small lumps in his reduced carcinoma, but cannot be persuaded to take further treatment.

Another who had no erections for one and one-half years had a permanent return of this function. His prostate showed a striking reduction. Previously he had been an invalid; after radium he gained 18 pounds, started in the mild work of shoveling snow and lifting ash cans and now is doing a full day's work in a machine shop twenty months after his first treatment. At the present time his whole prostate feels normal (Dr. Keyes). There are still suspicious lumps present and he probably still has carcinoma. We have, however, more than held the disease in check for twenty months. The history of two other cases are interesting enough to report:

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J. J. C., a man aged 60, complained of urinary frequency, chiefly at night (three to four times) for the past six months, then acute retention. He has lost about 8 pounds in weight. Prostatic examination shows a flat, irregular prostate with prominent nodules at prostatovesicular junction extending into the vesicles. (Examination with Dr. Keyes). Several other physicians examined the case and thought the diagnosis was not positive, but it was very suspicious of carcinoma. Forty-five mc. of radium was inserted in the right lobe for seven hours, and in the left lobe for five and one-half hours Feb. 8, 1916.

March 17, 1916, the patient reports he does not get up at all at night to urinate; he is doing a full day's work and had no pain after the radium.

May 23, the radium was repeated, after which he had pain and frequency of urination for a few days.

October 16 (examination with Dr. Keyes). The patient lost 2 or 3 pounds, but is the picture of health. He has never been catheterized since beginning the radium treatment. There is a lump as large as a pea at the right prostatovesiculo junction, nothing in vesicle or along the upper border of prostate. There is a ridge along the lateral edge of the right lobe not extending beyond the prostate, nothing in vesicles.

Jan. 16, 1917, his carcinoma has grown distinctly larger (examination with Dr. Keyes) and he has carcinomatous lumps at either outer margin of his prostate. He was given more radium which burned him a good deal. This burn lasted for two and one-half months. Today, sixteen months after his first irradiation, he has "the small possible point of induration on left edge of prostate and possibly very slight induration high up in right seminal vesicle" (Dr. Keyes).

Case 9.—M. H., aged 65, had a sloughy, pedunculated carcinoma removed from the neck of the bladder by Dr. Keyes. This grew from the prostate, no removal of which was attempted. The pathologic examination (Dr. Ewing) revealed a solid carcinoma composed of small and large groups of compact tumor cells, with very little stroma. The cells are of medium size, polyhedral, with hyperchromatic nuclei. The vessels are scanty. There is no necrosis. It is impossible to state from the section whether there is any infiltration of the bladder wall. In structure the tumor is a fully developed carcinoma.

June 6, the right lobe of the prostate, which had a hard ridge, was treated with 93 mc. of radium.

September 12, the patient did not have to rise at night. He went from four to six hours without urinating. He had gained 15 pounds. The lump in the right lobe was about gone. Drs. Keyes and Jeck saw it as an infiltration running up into the right vesicle. This was treated with radium.

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Today, one year after his first radium, he has a clean bladder and prostatic urethra, some induration in the right seminal vesicle, but is doing a full day's work.

These are the encouraging results. We have had many that have been discouraging. But we have treated all stages, thirty or more cases out of thirty-nine being advanced carcinoma.

TECHNIC OF RADIUM APPLICATION INTO THE PROSTATE

The emanations are placed in the end of a needle (gold or steel) extending from the tip 1½ inches along the sheath. These needles are from 4 to 6 inches long, and are inserted through the perineum into the prostate or further into the vesicles. The perineum is anesthetized with 0.5 per cent. novocain and epinephrin, which makes the insertion of these needles practically painless. The needle is left in one lobe for six hours and then changed to the other lobe. A finger in the rectum is used to guide the needle. Little or no pain is felt during the sojourn of the needle (twelve hours) and the patient can either urinate or be catheterized. This means at most but twenty-four hours in the hospital; from 50 to 75 mc. of radium are used in the end of the needle. Radium used in this way is practically unscreened, and the maximum effect of the radium takes place directly in the center of the carcinomatous nodule. The patient usually has pain in the prostate and urinary frequency beginning about three days after irradiation, and lasting a number of days to some weeks. In some cases in which I have used large doses the reaction has been severe. One has to be extremely careful about second or subsequent irradiations; the tissue seems to be much more sensitive to radium after the initial dose. Nearly all of my patients have been irradiated but once in two or three months, and no second treatment is given until the effect of the first has entirely passed over. The first dose should be as large as possible, and the result

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obtained seems to be in relation to the amount of burn the patient has.

The primary effect of the radium may be to increase the amount of residual urine (if there be any). The ultimate effect of the radium application on residual urine is probably nil, the amount neither increasing nor decreasing. Hence those patients who have chronic retention of urine require either the catheter or operation in addition to irradiation. It would seem wiser not to operate until the carcinomatous prostate had been thoroughly irradiated, and it would seem wiser not to operate at all if the patient can be trained to the use of the catheter.

No sloughs have resulted from the radium needles.

The pathologic examination of prostates removed after irradiation is of interest. In one case in which the prostate was removed because of urinary retention a moderate dose of radium was given five months before the prostatectomy. The prostate had been considerably reduced in size following the radium treatment. Dr Ewing reported as follows:

> Material consists of several lobulated opaque portions of prostate making a mass as large as a hen's egg. Much of this has the honeycomb appearance of chronic prostatitis, but some areas are very firm and solid. Two such areas, size of a bean, were sectioned. The main tissue of the gland shows lesions of chronic prostatitis with dilated glands and feeble epithelial proliferation. The solid areas show fibers of muscle tissue separated by rows of small epithelial cells with hyperchromatic nuclei. The appearance is that of diffuse carcinoma in a state of fibrosis. One area of adenocarcinoma is found in the center of a fibrosed area. There is no necrosis.
>
> In view of the history the diagnosis may be made of carcinoma, diffuse and adeno, arising on prostatitis, and undergoing atrophy and fibrosis from radium.

In another patient I gave one large dose of radium in August, 1916; the patient had a severe reaction. Five months later, because of retention, I took out as much of the prostate as I could. The pathologic examination is as follows: (Dr. Ewing.)

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Portions of tissue, including a segment of urethra, received. They show subacute inflammation, hemorrhage and regressing changes in an alveolar carcinoma. The tumor alveoli are represented by groups of five to ten epithelial cells with homogeneous nuclei, clear cytoplasm, lying in dense fibromuscular tissue. Traces of these alveoli disappear in the exudate of round cells in many pieces.

It will be necessary to examine many more prostates which have been treated by radium before one can be sure that the foregoing changes are due to the radium. The fact that carcinomatous lumps retrogress after radium treatment is "corroborative evidence" that radium causes a fibrosis in the carcinoma.

As far as we have observed clinically, most of the cases treated are of about the same degree of malignancy. There is a class of cases of prostatic carcinoma, however, of much more marked malignancy. In these the primary focus in the prostate is often overlooked, and the patient comes to be treated for a secondary focus. There have been three such cases at the Memorial Hospital, in two of which there was a large carcinoma of the neck and it was only by examination in one case and necropsy in the other that the primary focus in the prostate was found. Another patient, one month after radium treatment, appeared with a secondary tumor in his neck and died shortly after. Such cases are apparently very malignant and it is a question if we ever get them early enough for any treatment to count.

Very large carcinomas with cachexia and loss of weighth are beyond radium or any other treatment.

Only time will tell us whether any of our patients have been cured. At the present time we can state that in fairly early cases a marked regression of the prostatic lumps, and in some cases a complete disappearance of these, has taken place. Accompanying this retrogression the patients have improved in weight and bodily strength. Radium has done more for these patients than operation or any other known therapy.

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ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. LEWIS AND MOORE, GERAGHTY, AND BARRINGER

Dr. Edward L. Keyes, Jr., New York: We are fortunate to hear carcinoma of the bladder and prostate discussed from two such different points of view as those of Drs. Geraghty and Barringer, because as nearly as one can make out from simply listening to the papers as read, although the action of the individual mind is different in the two cases, I should say very markedly different, their conclusions are much alike. Dr. Geraghty manifestly hopes we may achieve a scientific distinction between the different types of bladder tumors, a hope which he frankly admits is not fulfilled at present, in practice at least, because we await, as Guyon did, in the clinic, the papilloma of statistics.

Nevertheless, the ultimate conclusion from the paper is that the physical means (burning with the high frequency current and with radium) are most efficient for the less malignant tumors of the bladder. Dr. Geraghty would exclude the infiltrating type of tumor, the one which he labels the papillary carcinoma, from radium treatment at all. Dr. Barringer's results would lead us to hope that radium might benefit some of the infiltrating tumors, but certainly most of them resist treatment by radium.

As regards carcinoma of the prostate, I confess I have been a little more enthusiastic about "cures" than I am now. Without being cured these patients may stay in very good health, but even those who get brilliant results from a single treatment, like the two men shown here, have to be treated again and again to keep those results good. Of course, the condition of the prostate itself is no index of the patient's general health. I saw a patient recently who was treated with radium elsewhere and whose prostate feels almost normal, but who is dying of carcinoma in his lumbar glands. But one would expect to cure patients captured early enough for radium treatment at a time when the carcinoma has not extended beyond the prostate. I do not quite understand how Dr. Barringer's patients get such improvement without complete relief. It seems to me that they ought by this time to decide either to die of their carcinomas or else get entirely well. And I am in some doubt whether these lumps are carcinomas or scars from the repeated burning. I confess I think they are carcinoma.

Dr. Geraghty has noted that fulguration after radium works better than fulguration before radium. It seems possible that those tumors would have disappeared if he had been able to keep his hands off them for a sufficient number of months after the radium. I have seen a case of what Dr. Geraghty would call malignant papilloma improve very much in the second three months after a dose of radium.

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Dr. William F. Braasch, Rochester, Minn.: As Dr. Geraghty has pointed out, the treatment of tumors of the bladder unquestionably has been greatly improved in recent years. It is reasonable to assume that in the first attempts to remove tumors by these less formidable measures a certain number of unsuitable cases would be treated, with consequent failures. If we were to judge the comparative value of non-operative methods from statistics of past years, the operative procedure would suffer very much by the comparison. This is illustrated in recent papers by Drs. Gardner and Young.

With improvement in the nonsurgical treatment of bladder tumors there has also been a distinct improvement in their surgical treatment. I am under the impression that the mortality is now considerably less than 12 per cent., which I think Dr. Barringer stated. If the cases are carefully selected there is no reason why the mortality from resection of carcinoma of the bladder should be higher than that following the average operation on the bladder.

The improvement in surgical technic has been along several lines. First, the bladders are cleaned up. Many of the patients with bladder tumor have a coincident cystitis and pyelonephritis and should be treated prior to operation much the same as patients suffering with prostatic conditions. Second, the wound should be carefully protected at the time of operation to prevent infection. Third, resection with the cautery knife is better than with the ordinary knife, and, together with cauterization of the surrounding area, should preclude any infection of the wound area. Fourth, formerly the ureters were often transplanted into other portions of the bladder with poor success, and sometimes with the death of the patient. If the ureter is markedly diseased, as it frequently is, it may be simply ligated and dropped into the wound. In such cases the kidney is usually largely destroyed and the patient does not suffer much reaction.

With the last year or two I have frequently seen patients who had been fulgurated over long periods of time. One patient had had forty fulgurations in two years. When I cystoscoped him it was evident that he had carcinoma and that it was too late for resection. Undoubtedly the tumor could have been resected if the patient had been operated on earlier.

I wish to emphasize that if, after three or four fulgurations, and possibly after using radium, the tumor does not markedly decrease in size, there is no excuse for continuing such treatment, and surgical procedures should be used. We have tried radium alone in a few cases of carcinoma, but with poor results. I disagree with Dr. Geraghty when he says that if a tumor of the bladder cannot be resected there is no object in attacking it surgically. Unquestionably good results can be obtained by using a cautery and searing the tumor almost to the muscular wall.

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Dr. G. G. Smith, Boston: I should like to bear witness to the efficiency of radium in one case which I have had under personal observation. About two years ago I operated on an elderly man and took out an adenomatous prostate and a papilloma of the bladder. He did very well for two years. About Christmas I cystoscoped him and found he had an infiltrating growth extending upward from the sphincter. I sent him to Dr. Barringer, who treated him with one application of radium. That was some six weeks or two months prior to this meeting. I cystoscoped him recently and the growth had entirely disappeared, as far as one could tell. There was some sloughing around the base of the bladder.

In regard to the treatment of diverticulum, there is one point in the technic. I am not sure whether it has been put on record or not. After a diverticulum has been freed outside of the bladder by dissecting around it, it is easier to cut off the diverticulum and to approximate the cut edge if the diverticulum is inverted so that it projects into the bladder. The cutting and suturing can then be done inside the bladder in a more accessible situation.

Dr. Leo Buerger, New York: The great value of histologic examination in determining the presence of malignancy is not sufficiently appreciated, because adequate material is rarely obtained by the cystoscopist. I have, therefore, made it a routine for a number of years to attack all papillomas situated in accessible portions of the bladder with the snare, through my operating cystoscope. With this procedure we can often succeed in removing papillomas *en masse*, sometimes in two or more pieces, and can often completely eradicate the growth in one, two or three sittings, following up the removal of the growth by fulguration of the pedicle. Thus, not only is the time of treatment, the number of séances of the fulguration method, much reduced, but the pathologist receives adequate material for the thorough investigation of the nature of the tumor.

I think it is bad teaching that permits the cystoscopist to determine by the effects of fulguration as to whether a given tumor is malignant or not. Many men are treating such tumors who are not sufficiently expert to know whether a tumor is responding or not, the lack of response being attributed to faulty technic, improperly applied or improperly functionating current, or what not. Thus, patients have been referred to me after having been subjected for weeks and months to the fulguration treatment, in which the application of the snare or operating forceps through the operating cystoscope permitted a diagnosis of carcinoma at the very first visit.

The snare is a simple instrument, and with a little practice can be applied almost as easily as a ureteral catheter.

Dr. Keyes: Do you fulgurate at the end of each treatment?

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Dr. Buerger: Whenever feasible I fulgurate at the end of each treatment.

Dr. Martin Krotoszyner, San Francisco: With reference to the method used in the treatment of diverticulum of the bladder mentioned by Dr. Smith, I recall a patient 73 years old in whom a very large diverticular sac was drawn into the bladder, just like one would turn a glove finger; the sack was then resected and its cut edges were stitched by several rows of catgut sutures. The patient eventually made a good recovery.

While the early and radical operative removal of malignant bladder tumors must be always recommended and carried out wherever feasible, the observation, nevertheless, that not infrequently patients live longer without than with operative interference would open the question whether, in the absence of distressing symptoms, an operation is indicated in all cases and under all circumstances.

Dr. W. C. Quinby, Boston: I want to add my mite to the paper of Dr. Lewis on diverticulum of the bladder by the brief report of one case. A man aged 55 had suffered from intermittent chills and fever, which had kept him a chronic invalid for twenty years, until I eventually got hold of him and succeeded in demonstrating and removing a large diverticulum on the right side of his bladder, much in the same way as Dr. Lewis has detailed to us. The first point which I wish you to note is the long story of invalidism which these patients so often bring. I hope that that period is going to be much diminished in the future. It is now being much diminished; the more so as the attention of the general practitioner is more forcibly called to such lesions as a cause of pyuria. The second point of note occurred during the convalescence of this patient. While water was being given in very liberal amount to help out the severe renal infection, the heart suddenly became irregular and weak. It was impossible by the usual means to rule out an acute dilatation from too much fluid. The electrocardiogram, however, came to our assistance. The tracing showed the condition to be due to an auricular fibrillation and not to decompensation of the heart due to the fluid. I was able to continue the fluid, and, under appropriate treatment, the fibrillation ceased. The patient is now cured of his diverticulum.

Dr. Bransford Lewis, St. Louis: I think that Dr. Quinby and I have a similar impression as to the value of presenting these reports, and that is one of encouragement for undertaking, in the first place, the diagnosis of these cases, and, in the next place, operating. One of these patients whose case I reported had a longer history of trouble than the one that he speaks of. He was 42 years of age and gave a history that ever since he could remember he had had chills and fever and could never clean his bladder; he was always septic; and he

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recovered just as promptly as did the other. Before I undertook these operations I was rather fearful that they were difficult to carry out and that the convalescence would be prolonged. I remember in certain cases of other operators the patients did have very difficult convalescence. These men both were well within ten days after the operation, and were thoroughly comfortable, urinating and emptying the bladder completely, and happy over the result. I think encouragement is the keynote of the presentation of the cases.

Dr. John T. Geraghty, Baltimore: With regard to Dr. Keyes' remarks about the disappearance of these tumors under radium, I think that is perfectly true. In some of the cases which have been allowed to go without fulguration the tumors have disappeared. We have used fulguration to cause a more rapid disappearance of the tumor. Those which disappeared under fulguration after irradiation would probably have disappeared under irradiation alone.

With regard to the technic of resection, we make it a rule to burn the tumor vigorously before attempting resection. As soon as the bladder is opened the whole tumor is destroyed down to the base. Whether one carries on the dissection by the knife or the cautery makes little difference. When one destroys the whole area thoroughly it amounts to resecting that area of the bladder wall.

With regard to the cases mentioned by Dr. Braasch, it has been my experience that the tumors which we can destroy by the cautery are tumors that practically always respond to fulguration and radium. Those cases with infiltration I do not think would be cured by destroying with the cautery. There are a few cases in which the tumor is a definite, infiltrating carcinoma with a pedicle, and that tumor must be resected. Cutting off the tumor through the mucosa at the pedicle with the cautery is probably just as efficient as a resection.

With regard to the remark that the mortality from resection should not be as high as 12 per cent., our mortality in twenty-two resections has been one death.

Dr. B. S. Barringer, New York: I see I will have to get together with Dr. Geraghty. It has been my fault that I have not been able to make a sharp distinction between malignant papilloma and papillary carcinoma. For practical purposes I have come down to these two types, calling a type which may or may not be sloughing, which shows carcinoma by microscopic examination, and is of a general cauliflower growth, a papillary carcinoma. The flat type with induration I call an indurated carcinoma.

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SYPHILIS OF BLADDER

H. A. FOWLER, M.D.
WASHINGTON, D. C.

Syphilitic disease of the bladder has been considered a rare affection. In the older textbooks it is sometimes not mentioned at all or it is dismissed briefly or its existence is even denied. In the most recent works the disease is considered so rare as to merit only the briefest mention. Within the past sixteen years, however, a considerable number of carefully studied cases have been recorded in widely scattered reports. These furnish sufficient data for a fairly comprehensive clinical study.

The history of this affection falls naturally into three periods. The first comprises those rare observations on syphilitics coming to necropsy in whom ulcers, tumors, or perforations of the bladder were discovered and were considered syphilitic in origin. This period extends to 1879, when Proksch critically reviewed all the published cases up to that time. He found only six cases which could be considered definitely proved (Morgagni, Ricord [two cases], Virchow, Vidal di Cassis, Tarnowsky).

To the second period belongs a small number of cases observed clinically in which the diagnosis was confirmed by the disappearance of all symptoms following antisyphilitic treatment (Morris, Grivtsoff [two cases], Chezelitzer, Margoulies, Towbien). No direct examination of the bladder lesion was made.

The third period begins in 1900, when Matzenauer published the report of his case and described for the first time the cystoscopic appearance of tertiary syphilis of the bladder. During the past sixteen years the

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number of observations has rapidly increased, so that up to the present time about forty cases have been reported. In 1909 it was shown that the bladder is involved in the secondary stage. According to Levy Bing, a systematic examination of the bladder during the secondary stage of the disease will reveal that a more or less characteristic erythema, resembling the roseolar rash on the skin, and also superficial ulcerations are not rare. As these produce few or no symptoms they may be easily overlooked without a routine cystoscopic examination.

REPORT OF CASE

History.—N. G., boy, aged 19 years, came to the clinic complaining of frequent and painful urination, and passing bloody urine. His past history was unimportant. There was no history of syphilis or gonorrhea. For the previous three months the patient had had to pass urine frequently, night and day. On an average he got up eight times at night to void, and he urinated every ten minutes during the day. Marked pain in the perineum and along the urethra accompanied each urination, and the pain persisted several minutes after the act. At times the urine was quite bloody; at other times it was only slightly tinged with blood.

Examination.—The patient was a healthy looking young colored farmer boy presenting the facies characteristic of a painful urinary disorder. The chest and abdomen were negative. The external genitalia were normal. The urine was uniformly turbid, owing to the presence of pus, bacteria and red cells. It was slightly acid in reaction, and the specific gravity was normal. There was a slight cloud of albumin, but there were no casts. There were no scars on the penis or other evidences of healed cutaneous lesions. The inguinal axillary and epitrochlear glands were definitely enlarged. This glandular enlargement without apparent cause aroused suspicions of syphilis, and suggested the possibility of a syphilitic infection of the bladder. A Wassermann test was made and reported as strongly positive.

Cystoscopic Examination.—This was painful despite the free use of cocain. There was a marked general cystitis. All markings of the vesical mucosa were completely obscured. The mucous membrane was of a uniform rose color and had the appearance of a curtain of uniform color spread out over the inner wall of the bladder. It was difficult to locate the ureteral openings. Just to the outer side of the right ureteral opening was a single small ulcer, which was bleeding. It was

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about 1 cm. in diameter, with an irregular outline and an inflamed base. No other ulcers could be seen. The appearance of the ulcer suggested tuberculosis, but no tubercles could be found in the bladder, and the urine was negative for tubercle bacilli on repeated search.

Treatment and Result.—It was decided to apply the therapeutic test without any other form of treatment whatever, either local or general. Salvarsan, 0.6 gm., was given intravenously. The following day the patient noticed a definite decrease in frequency of urination. The improvement was continuous and rapid, and in a week's time the patient was able to retain the urine for three hours with little or no pain on urinating. A second injection of salvarsan was given, followed by mercury by mouth. Cystoscopy three weeks later revealed a remarkable change in the bladder. No trace of the ulcer could now be found. The ureteral openings appeared normal. The peculiar appearance of the mucosa had entirely changed. Normal markings of the mucous membrane were now clearly distinguished, with here and there discrete patches of inflammation such as one sees in an ordinary cystitis of a mild degree. No local treatment had been given previous to this examination. The urine was still turbid, owing to the presence of bacteria, pus cells and an occasional red cell. The improvement in the patient's condition was most striking. He was now able to retain his urine for three or four hours without discomfort, and voided without the marked pain and tenesmus of which he complained when he came under observation. His condition was so satisfactory that he insisted on going home to work, as he declared he was perfectly well.

COMMENT

There are several points of interest in the foregoing case report. The symptoms were those of a severe cystitis coming on without apparent cause. The urine showed an acid total pyuria, together with red cells and bacteria. The condition suggested tuberculosis of the urinary tract with a secondary infection, probably colon bacillus. Repeated search for tubercle bacilli, however, was negative. There were no changes to be made out in the epididymides, vesicles or prostate.

It so happened that I was looking for a case of syphilis of the bladder at the time. The general glandular enlargement aroused my suspicions of syphilis, and these were strengthened by a strongly positive

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Wassermann test. Cystoscopy revealed, in addition to a solitary ulcer about the right ureteral opening, a peculiar appearance of the mucous membrane such as I had never seen before. But there was nothing about the cystoscopic findings which I could consider characteristic of syphilis. Certainly the ulcer might easily have been mistaken for tuberculosis. I could not, as a result of my examination, say that the bladder lesion was syphilitic. It was determined, therefore, to put the patient on antisyphilitic treatment and to watch the effect of this on the symptoms and the vesical lesion. I was careful to avoid any local treatment whatever, or any internal medicine to relieve the symptoms. The marked and prompt improvement in the symptoms and the ultimate disappearance of the vesical lesion following salvarsan alone seems to justify the diagnosis of syphilis. It is of interest to note that no history of syphilis was obtained in my patient. This only serves to emphasize the point to which attention has so often been called, namely, that the history in many of these cases is thoroughly unreliable.

ETIOLOGY

Lesions of the bladder occur during the secondary and tertiary periods of the disease. In the parasyphilitic diseases the bladder is commonly involved, notably in tabes. Age and sex have no influence on the development of the bladder lesions. As tabes occurs more frequently in males, however, the associated bladder disturbance is more often observed in this sex. Although more common in middle life, cases occurring at the two extremes have been observed: at 4 years (Tarnowsky) and at 66 years (Gayet and Favre[1]).

The secondary lesions usually appear within a few months after infection, and are generally accompanied by lesions of the skin and other organs. Tertiary

1. Gayet and Favre: Jour. de Urol., 1915, 6, 152, three illustrations in color.

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lesions, on the contrary, appear after a much longer period, up to twenty-five years. The bladder lesion may be the only evidence of the disease. In other cases the active syphilitic lesions of other organs or healed scars may be found. The majority of cases so far recorded belong to the tertiary period. It is quite probable that involvement of the bladder during the secondary stage would be observed more frequently if a routine cystoscopic examination were made. The occurrence of mild symptoms of cystitis during this stage is easily overlooked. These are attributed to the usual causes and their relation to a specific infection is not considered, particularly as they disappear under salvarsan and mercury.

SECONDARY SYPHILIS

Nine cases of secondary syphilis of the bladder have been reported — six males and three females. The youngest was a child, aged 4 years, having been infected by its nurse. At necropsy extensive ulcerations of the mucous membranes, including bladder and urethra, were found. The liver was syphilitic. In all cases the bladder lesions were accompanied by secondary syphilis elsewhere — skin, mucous membranes, etc. Macules, papules and ulcerations have been described. Duroeux has described a macular eruption resembling roseola of the skin. In Fenwick's case (postmortem), papules were disseminated over the bladder mucosa resembling condylomas. The ulcers are usually multiple, from two to twelve, rounded or oval, superficial, with a slightly elevated edge and a necrotic base. They occur more frequently about the ureteral orifices, but may be found in other parts of the bladder. The adjacent mucosa is edematous, hyperemic, and the vessels are injected and prominent. The remainder of the bladder appears normal.

The symptoms of the secondary stage vary with the location and character of the lesion. In the case of Levy Bing there were absolutely no symptoms refer-

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able to the bladder, and the vesical lesions were discovered during routine cystoscopy. With ulceration at or near the vesical neck, symptoms of cystitis more or less acute are observed. Frequency, urgency, and tenesmus may be marked day and night, and are not influenced by rest. Pain is then a constant symptom referred to the suprapubic area or perineum, and radiating along the urethra, to the rectum and to the lumbar region. Hematuria when present is never profuse and is always terminal. The bladder capacity is reduced, and varies with the intensity of the symptoms.

The urine is often clear. In the presence of infection it is turbid, owing to the presence of pus and organisms. It may be bloody from the presence of red blood cells. The presence in the urine of the spirochete has been reported, but this observation has not been confirmed.

TERTIARY SYPHILIS

By far the greater number of cases of bladder syphilis so far observed belong to the tertiary stage of the disease. This may be due to the more pronounced symptoms associated with tertiary vesical lesions. Attention is thus directed to the bladder, and examination reveals the specific nature of the trouble.

Gummas of the bladder develop insidiously like all new growths, and in the early stages produce little or no disturbance. Urination is slightly more frequent and associated with mild discomfort in the region of the bladder, in the perineum, or in the urethra. Hemorrhage, sudden in onset and profuse, may be the first and only symptom noted. More often symptoms of cystitis develop and increase rapidly in intensity.

Hematuria is the most constant and most striking symptom of tertiary bladder syphilis. It closely resembles the hemorrhage of new growth of the bladder. It appears suddenly without pain, and is uninfluenced by rest or posture. It may continue for days

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or weeks and gradually subside, only to recur after a longer or shorter period. Complete retention may result from the formation of clots within the bladder. As a rule, hematuria increases with the duration and progress of the disease. Exceptionally it may be absent altogether.[2]

Pain is an inconstant symptom, and varies with the location of the lesion and the presence or absence of infection as a complication. In Simons'[3] case the patient complained of a dull dragging pain in the hypogastrium which had existed for two years. At first intermittent, it became constant day and night, and increased as the bladder filled. In some cases, pain is a marked feature of the clinical picture. It is likely to be more severe at the end of urination if the ulceration is located at the bladder outlet, and it is accompanied by violent tenesmus. Frequency of urination is a disturbing symptom in most cases. Slight at first, it rapidly increases until the patient voids every few minutes with pain and tenesmus. While the symptoms in advanced, long standing cases are very severe and distressing, the absence of marked symptoms in the presence of severe bladder lesions in the earlier stages is noteworthy. The development of the more acute symptoms probably coincides with the degenerative changes in the gummas, and ulcer formation. Often the bladder lesion is the only evidence of syphilis to be discovered. In the absence of a definite history, the specific nature of the disease is not suspected.

CYSTOSCOPIC APPEARANCES

As viewed by the cystoscope, two varieties of lesions occur: gummatous ulcerations and papillomatous growths. The former are more common; the latter are rare. They occur separately, but may exist together.

2. Picker, R.: Ztschr. f. Urol., 1913, 7, 192.
3. Simons, Irving: Case of (Syphilitic?) Ulcer of the Bladder, The Journal A. M. A., June 21, 1913, p. 1943.

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Such ulcers are formed by the breaking down of a gumma of the bladder at its center. They are usually multiple, there being one to three which are rounded or oval, and which vary in size, the largest being from 1.5 to 2 cm. in diameter. They are elevated above the bladder wall, projecting into the bladder cavity. They present a punched-out appearance with irregular borders and a grayish necrotic base. On the base of the ulcer one sometimes observes the necrotic material detached in places, leaving a red, nodular surface which bleeds freely. The surrounding mucous membrane is edematous, hyperemic and dark red or livid in color. The vessels are markedly injected and prominent.

The papillomatous lesions are very rare. In Margoulies' case (Case 1) there were three small growths the size of a small bean situated close together and located on the base of the bladder just outside the ureteral orifice. The appearance of these growths suggested cancer of the bladder, and an operation was advised. It was by mere accident that the operation was not performed, and iodid was administered. Prompt disappearance of the lesions followed.

Gayet and Favre[1] report a case (Obs. 2) of sclerogumma of the bladder and prostatic urethra. The bas-fond was elevated, thickened and reddened, and indurated. The fiery red surface presented a few small ulcers and numerous fissures giving the appearance of cerebral convolutions. The general appearance resembled that seen in cancer of the cervix which has involved the bladder wall. The same character of lesion is described by Picot.[4]

Syphilitic lesions of the bladder, both secondary and tertiary, develop slowly and show no tendency to heal spontaneously. The long duration of symptoms in the reported cases is a striking feature of the clinical history. The secondary lesions are superficial. The

4. Picot: Jour. de Urol., 1912, 2, No. 5.

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tertiary involve the deeper layers of the bladder wall, and unless arrested may result in perforation. Such perforation, developing rapidly and involving the peritoneal surface, may terminate in fatal peritonitis. If the process develops more slowly, a loop of bowel may become adherent to the bladder, and perforation into the bowel occurs. Thus syphilis is one of the etiologic factors in the production of vesico-intestinal fistula. Vesicorectal or vesicovaginal fistula may result from the perforation of the bladder base.

TREATMENT

A striking feature of bladder syphilis is its prompt response to specific treatment. This is characterized by the immediate subsidence of all symptoms and the gradual disappearance of the vesical lesions. On the other hand, the measures usually employed in the treatment of ordinary cystitis have no influence whatever on either the symptoms or the lesions.

Profuse and persistent hematuria, which is often the presenting and predominant symptom, quickly subsides and disappears completely in a few days after the beginning of treatment with mercury or after the administration of salvarsan. No less striking is the prompt subsidence of all signs of vesical irritation, frequency, urgency, tenesmus, and a gradual return of the vesical capacity to normal.

The gradual healing of syphilitic lesions of the bladder may be followed by repeated cystoscopy. At the second congress of German urologists, Ernst Frank presented a series of cystoscopic photographs demonstrating the gradual healing and final disappearance of these lesions under treatment. Similar demonstrations have been made since by other observers.

It is the strikingly rapid subsidence of symptoms under specific treatment that makes the therapeutic test so valuable in differentiating syphilitic from non-syphilitic vesical lesions.

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The bladder changes occurring in certain diseases of the nervous system which we now designate as parasyphilitic are too well known to demand discussion at this time. They have been considered in another place.[5]

1621 Connecticut Avenue.

ABSTRACT OF DISCUSSION

Dr. Martin Krotoszyner, San Francisco: I have seen one case that, judging from the therapeutic result, I feel justified in classing among the cases that are considered syphilis of the bladder. A baker of 60 entered the hospital on account of sudden, painless and abundant hematuria, as the cause of which a small papillomatous growth, situated near the trigon and midway between the ureters, was ascertained cystoscopically. The patient admitted previous syphilitic infection. He had married late in life and was the father of two half-grown, healthy girls. Suspicious scars and other skin manifestations were the only other objective findings. The Wassermann was strongly positive. All bladder symptoms, including hematuria, quickly disappeared under combined antisyphilitic treatment. At a second cystoscopy, six months after the patient's discharge, the papillomatous excrescence was still visible, though apparently less prominent and reduced in size.

While I have observed a great many bladder lesions due to central or spinal syphilis, I have never seen a bladder ulcer the syphilitic nature of which, as in the case reported by Dr. Fowler, became obvious through its prompt reaction to specific treatment. My own observation, therefore, does not constitute a classical case of bladder syphilis. Such cases must be very rare indeed, and I recall in this connection the statement of Casper, who doubts the occurrence of bladder syphilis, of which he, like other authorities, has never been able to obtain authenticated cystoscopic evidence.

Dr. Charles J. Watterston, Birmingham, Ala.: I can add one more case to Dr. Fowler's series. It is the case of a negro girl in whom we made a cystoscopic examination on account of hematuria. There was a small, raised ulcer about 1 cm. in diameter just below the right ureter and several smaller erosions running down toward the trigon.

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5. Besides the citations in the text, these additional recent cases will be of interest:

A critical review of the literature is given by Paul Asch in connection with his paper in the Zeitschrift für Urologie, 1911, **5**, 504.
Pereshivkin: Ztschr. f. Urol., 1911, **5**, 732.
Mikhailoff: Ztschr. f. Urol., 1912, **6**, 215, two colored plates.
Mucharinsky: Ztschr. f. Urol., **6**, 376.
Pedersen, James: Med. Rec., New York, 1916, **90**, 235.
Baker, Theodore: Surg., Gynec. and Obst., **24**, 187.

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The patient had a strongly positive Wassermann, there were other evidences of syphilis, and the lesions healed completely under antisyphilitic treatment; that is, salvarsan intravenously, followed by mercury.

Dr. H. A. Fowler, Washington, D. C.: Formerly we were led to believe that syphilis of the bladder did not occur, or, if it did exist, was rare. The experience of competent observers during the past few years compels us to change this view, and we now believe that this disease is not so rare as it was thought to be. This is in line with our knowledge concerning syphilitic infection of other mucous membranes. It is probably our failure in diagnosis rather than the rarity of the lesion that is responsible for the prevailing opinion.

There are one or two points to emphasize. There are no characteristic cystoscopic appearances by which syphilitic lesions of the bladder can be recognized. The diagnosis cannot be made by cystoscopy alone. The lesion cannot be differentiated in all cases by its cystoscopic appearances from tuberculosis or new growths. There are a number of cases reported in which syphilis was mistaken for cancer. In the secondary stage the lesions are superficial and may produce no symptoms whatever. Hence they are easily overlooked.

After all, the essential point is to have in mind the possibility of syphilis of the bladder if we are to avoid errors in diagnosis. The mistake has been made of advising operation for a supposed new growth, then to see the lesion clear up rapidly under antisyphilitic treatment.

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ROENTGENOGRAPHIC EXAMINATIONS OF THE URINARY TRACT

REVIEW OF A SERIES OF ABOUT 500 CASES

E. W. CALDWELL, M.D.
NEW YORK

This paper presents the results (some more and some less completely) obtained in 500 consecutive roentgenographic examinations of the urinary tract occurring in private practice. These cases were referred by 230 different physicians or surgeons, and it has been impossible to obtain full clinical records of all of them.

It will be appreciated that the accuracy and the extent of the clinical observations made by so large a group of men will vary considerably, and that the data derived from them cannot compare with the information which may be obtained from a hospital in which all of the work is done by a comparatively small group of men accustomed to working together.

In a few of the examinations, pyelography was combined with the ordinarily roentgenographic examination; but the number of these cases is small, and they have not been considered in this series. In a few cases our own records are incomplete, and these have been rejected from the series. Sometimes our records have been borrowed and not returned. There remain 455 cases of which we have fairly complete records of the roentgenographic reports. No case has been rejected from the list in which it is even suspected that an error was made in the roentgenographic diagnosis.

In practically every case, the report of the examinations was made from the roentgenograms alone and without taking into consideration the clinical history, the symptoms or the urine investigation. The results

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are, therefore, what may be obtained with the roentgenograms alone, not aided by pyelography and without any clinical help.

It must be obvious that some of the errors recorded might have been avoided had we used the combined method, and some of the cases reported doubtful or indeterminate would probably have been reported positive had we been in possession of the clinical data. On the other hand, it is likely that in a certain number of the doubtful or indeterminate cases, the possession of the clinical data might have led us into positive statements which would later have proved incorrect.

In order to allow sufficient time for subsequent observation, no examinations made later than Dec. 31, 1916, are included. All examinations in this series were made during 1914, 1915 and 1916, a period in which the technic was practically the same as that of today. The results, therefore, represent fairly what may be expected under present conditions from roentgenographic examinations alone. Before the beginning of the war, the photographic materials available were much more reliable than now, and the accuracy of results obtained in these examinations was somewhat greater.

In order to check up the results of the roentgenographic examinations and to obtain clinical data, the following questionnaire was recently mailed to every physician or surgeon referring a case in this series:

Date of roentgen-ray examination:

1. Was the roentgen-ray examination helpful to you in diagnosis?
2. Has the patient been operated on?
3. What did operation disclose?
4. Result of cystoscopy, if any:
5. Were calculi passed?
6. Did urine contain: (*a*) Blood? (*b*) Pus? (*c*) Tubercle bacilli?
7. Were symptoms due to lesions outside of urinary tract: (*a*) Appendicitis? (*b*) Oophoritis? (*c*) Salpingitis? (*d*) Colitis? (*e*) Gallstone? (*f*) Other causes?

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8. Any additional information bearing on the accuracy of the result of the roentgen-ray examination:

The results of the roentgenographic examination of the whole 455 cases have been tabulated and are presented here, but we have succeeded in obtaining clinical data in only about 290 of these cases and some of these replies are incomplete. We have, however, accepted no reply which does not give a satisfactory answer to the question regarding the presence or absence of calculus.

The chief thing sought in these examinations is to determine the presence or absence of calculus. In the 455 cases of which we have complete records of the roentgenographic examinations, calculi were reported in 119 cases. In 314 cases no calculi were reported, and in twenty-two cases there were suspicious shadows which we reported as doubtful. The plates of some of these doubtful cases presented shadows which could be explained either by urinary calculi or by extra-urinary calcareous bodies. In all of these doubtful cases it was recommended that additional examination be made with the opaque ureteral catheter in the ureter, but in most of them this procedure was declined as unnecessary. In a few of the doubtful cases, the plates were not satisfactory because of incomplete preliminary clearing out of the digestive tract. Whenever possible, additional plates were made to correct these defects, but there remain some cases in which it was impossible to obtain an additional examination. In more than half of the unsuccessful and doubtful cases, we could not make the examinations as complete as we desired.

Of the 119 cases in which calculi were reported, twenty-two presented two or more calculi. The total number of calculi reported was 158. Of these, thirty-eight were in the left kidney; thirty-seven in the left ureter; thirty in the right kidney; twenty-eight in the right ureter; nineteen in the bladder, and six in the prostate. Of the 119 calculus cases, forty-nine

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were proved correct, either by operation or by the passing of calculi. In the remaining seventy of these cases we have been unable to obtain definite information that the calculi have actually been seen. We have regarded no case as proved unless the calculi have been recovered.

We have been unable to obtain reasonable evidence that there was any error in the diagnosis of calculus in any of these 119 cases reported positive. Of the doubtful cases, calculi have been demonstrated by operation in two cases and by passing of stone in three cases. In the remaining seventeen, we have no information as to calculus, but other probable causes for the symptoms have been reported in most of these.

Of the 314 cases in which the roentgenographic examination was reported negative for calculi, stones have been subsequently passed in five cases. In two cases stones were removed by operation. We have, therefore, seven proved errors in the series of 455 reports, a percentage of about 1.5 of the total number of cases examined. Perhaps it would be more accurate to reckon this percentage as 2.4 per cent. of the 290 cases in which we were able to obtain satisfactory replies to our question blank.

The more I have worked on these tables of statistics, the more I have been impressed with the impossibility of obtaining absolute accuracy. There are doubtless some errors in the clinical records that have been kept. Another source of error which has been difficult to avoid is that in several cases in which the report of the roentgenographic examination was negative, we were told that stones had been removed by operation, but on more careful investigation it was found that the calculi were passed or removed by operation prior to the time of the roentgenographic examination. This difference in the date was in some cases overlooked by the attending surgeon, who reported us in error, when in reality no mistake was proved.

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Comparisons have frequently been made between the expert statistician and various kinds of liars, always to the disadvantage of the statistician. Since preparing this paper, my sympathies are all with the statistician.

While the chief function of the roentgen ray in examinations of the urinary tract is to determine the presence or absence of urinary calculus, other useful or interesting information is incidentally obtained. In many of the cases reported some information was given as to the size, outline, position or density of the kidney shadow. In this series there were reported such anomalies as sixty-two in size of kidney, seventeen in outline, fifteen in position and thirteen in the density of the kidney shadows. In a few of these cases the abnormalities of the kidney shadow were proved to be connected with a pathologic condition of the kidney.

In the course of these examinations many other calcareous bodies were shown in the neighborhood of the urinary organs. In this series we have reported eighty cases with phleboliths, ten with calcified mesenteric glands, three with intestinal concretions, and seven with gallstones.

Pathologic conditions of bones and joints are frequently observed in the course of examinations of the urinary tract. In this series there were reported forty cases of ostearthritis and five cases of other disease of the bone or joint. It seems likely that in a few of these cases, disease of bones or joints was the cause of the symptoms; but we are unable to obtain accurate data as to the number.

Anomalies in the development of the lumbosacral region are not uncommon. While these anomalies may be of only academic interest, they are shown perfectly well in roentgenographic examination of the urinary tract, and I think they should always be noted, since they may occasionally be proved to have an important bearing on the symptoms. In some of these

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cases it was found that one or both transverse processes of the fifth lumbar vertebra were enlarged and articulated with the sacrum and ilium. This anomaly is commonly described as sacralization of the fifth lumbar vertebra. We have noticed that a number of these patients presented the symptom of persistent pain in the back after some strain or unusual exertion, when no other cause could be found to account for the symptoms. This pain has been most frequent in cases in which there is unilateral sacralization. The pain is usually felt on the side opposite the sacralization.

In another class of anomalies, of which ten are reported in our list, there was incomplete union of the first sacral vertebra with the rest of the sacrum.

In some of these cases there were six vertebrae without ribs, between the twelfth dorsal and the sacrum. In others there were only four vertebrae in this region without ribs.

The answers to some of the other questions in our blank are given below. In answer to the first question as to whether the roentgen ray was helpful in diagnosis, 216 replied "Yes," and forty-four "No." In the remainder no answer was given. On looking over these replies we are impressed with the fact that the answer to this question was purely a subjective matter and depended somewhat on the weather or the state of digestion of the person answering. Many answered the question in the affirmative when our report of the roentgen-ray examination was negative and seemed to me of no value. In other cases in which the roentgen-ray examination gave much definite information as to size, number and position of calculi, the reply was that the roentgenographic report was not helpful.

The answer to Question 2 of our blanks showed that of the 290 patients concerning whom we have clinical data, seventy-two were operated on and 190 were not operated on. In forty-three cases cystoscopic examinations were made, and in 202 cases no cystoscopy

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was made. Calculi were passed in twenty-two cases, and in 229 cases it was reported that no calculi had passed.

The replies showed also that of the negative cases symptoms were accounted for by appendicitis in six; by ovaritis or salpingitis in six; by colitis in one; by gallstones in seven, and by other causes in nine cases.

In 242 cases the urine examination showed blood, and in 247 cases pus was shown.

In the forty-nine cases in which calculus was proved by operation or by passing the stone, the urine examined showed blood and no pus in seven cases; pus and no blood in two cases; both pus and blood in thirteen cases; neither pus nor blood in three cases, and in six cases no report. Of the remaining seventy cases reported positive for calculus, but not proved by operation or passing of stone, two presented blood and no pus in the urine; two pus and no blood; ten presented both pus and blood; three neither pus nor blood, and in forty cases there was no report. Of the five cases in which the roentgen-ray examination was doubtful, but in which the presence of calculi was proved, both pus and blood were found in the urine of two; one presented blood only, and one had no pus or blood and on one there was no report. Of the doubtful cases not proved positive, two had both pus and blood; three pus only; two blood only, and five neither pus nor blood, and five were not reported. Of the cases in which the roentgenogram was negative, nineteen revealed blood only; twenty-five pus only; fifty-four both blood and pus, and sixty-eight no blood or pus.

It will be observed that of the cases in which the presence of calculus was proved, about 52 per cent. presented both blood and pus in the urine. In these cases only 12 per cent. presented neither blood nor pus in the urine, and of those cases reported negative, nearly 41 per cent. presented neither pus nor blood.

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The preparation of the data in this paper has impressed me with the difficulties of obtaining complete statistics of cases occurring in private practice, but I trust the results given will not warrant the usual uncomplimentary classification of the statistician.

I find that the number of our errors in the diagnosis of urinary stone is about twice as large as I had supposed, but the percentage is still smaller than that which is reported from examinations made in various hospitals or clinics. It is possible that if all the errors could be known, the percentage would be much higher; but I doubt it. A higher percentage of accuracy should be expected in private practice than in hospital or dispensary work. The success of the roentgen-ray examination for urinary stone depends largely on the intelligent cooperation of the patient. The average hospital or dispensary patients, especially those who speak some unknown foreign language, cannot be depended on to cooperate thoroughly in the success of the examination. They are very prone to breathe or to move during the exposures. In private practice more time is usually given to these examinations, and more plates are made. The economy practiced in most hospital roentgen-ray departments undoubtedly results in the sacrifice of accuracy. The duplication of plates and the use of the stereoscopic methods are not commonly employed in hospitals, and these procedures undoubtedly lessen the number of errors.

It is possible that the mode of life of some of the foreign population which forms a bulk of certain dispensary patients conduces to the formation of uric acid or urate calculi which are not readily demonstrated by roentgenograms. A small percentage of error must be expected even under the best conditions, but we should remember that there is no absolutely infallible method of diagnosis of urinary stone.

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DIFFERENTIAL DIAGNOSIS OF LESIONS OF THE URINARY TRACT FROM THOSE OF THE GASTRO-INTESTINAL TRACT

WITH SPECIAL REFERENCE TO CONCRETIONS IN THE APPENDIX AND TO ABDOMINAL TUMORS

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How physicians, previous to the discovery of the Roentgen ray, made correct diagnosis of obscure intra-abdominal lesions excites wonder and admiration. Present methods of diagnosis demand hours, and sometimes days, of painstaking combined urologic and Roentgen examinations. But the satisfaction of arriving at a correct diagnosis without an exploratory operation is ample reward for the time and energy expended.

While at times it has been possible only to finally determine the best site for incision, even this information has in certain instances "saved the day" by permitting of the removal of a tumor through a correctly placed incision such, for example, as the removal of an echinococcus cyst of the left kidney through a posterior incision in a case which, when first presented to us, had been diagnosed as a splenic tumor and would ordinarily have been approached through an anterior incision. Such an incision and attempt at removal of the kidney involved in this case, I am told by the surgeon who operated successfully through a *posterior* incision, would in all probability have ended disastrously for the patient.

The usual method of procedure in a case giving a history of serious intra-abdominal trouble has been to make a Roentgen examination without the use of

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any contrast substance in the urinary or digestive tract. If a suspicious shadow is observed, its nature and location are then worked out as accurately as possible by means of stereoscopic exposures, supplemented, if necessary, by contrast catheters or bougies or solutions in the urinary tract, or by contrast mixtures in the digestive tract, or, when present, injected into a sinus or fistulous tract.

Thus, in many instances, supposed cases of chronic appendicitis are found to be really cases of lesions in the urinary tract, or gallbladder, stomach, or duodenum. And, vice versa, supposed lesions of the upper digestive tract have been proved to be lesions in the appendix or urinary tract. In two instances on Roentgen examination for supposed duodenal ulcer a renal calculus was discovered and in both instances removed with complete relief from the digestive disturbances. In this connection one should always bear in mind the possibility of a patient suffering from two or more lesions, perhaps only one of which, however, is responsible for the patient's sufferings. An instance of this sort was that of a man presenting himself with a well-developed left inguinal hernia. This was successfully operated on, but the patient continued to suffer from his same dragging pain on the left side running down into his scrotum. Roentgen examination was then made for the first time and at once revealed a typical pyramidal-shaped shadow of a calculus in the pelvis of his left kidney. Examination with a contrast bougie in the ureter confirmed the diagnosis. Removal of the calculus gave the patient complete relief from his symptoms, but he has never quite forgiven the surgeon for the first operation, although it cured his hernia.

Another remarkable case of mistaken diagnosis lasting over a period of nine years, corrected in a few minutes by Roentgen examination, was that of a patient suffering from a sinus supposed to be due to tuberculosis of the hip. Roentgen examination

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revealed a calculus in a low-placed kidney. Removal of the calculus resulted in a closure of the sinus.

Another similar case was that of a sinus supposed to be due to a tuberculous rib. The lesion had been present for years. Roentgen examination at once revealed a calculus in the kidney, and its removal caused the sinus to close.

Other cases are illustrated in the accompanying lantern slide demonstration and summarized histories.

REPORT OF CASES

CASE 1.—A man, C., aged 21, a painter, became ill three weeks before admission to the hospital, with pains in the right iliac region, vomiting and fever. The attack lasted five days. Pain gradually disappeared, but reappeared two days later in the same spot and persisted up to his admission to the hospital. There was no further vomiting or temperature elevation, his appetite was fair, and his bowels had been irregular. On admission his temperature and pulse were normal. The leukocyte count was 15,500 with 78 per cent. of polymorphonuclear cells; on the following day the leukocyte count fell to 10,000, with 66 per cent. of polymorphonuclears.

Physical examination demonstrated slight rigidity and tenderness in the lower part of the right inguinal region, but no mass could be felt. On rectal examination a sense of resistance was felt in the right side of the pelvis above the prostate, and a slight mucopurulent discharge from the rectum was present.

Roentgenographic examination showed a shadow in the right side of the pelvis and a diagnosis of acute appendicitis with abscess, which had probably perforated into the rectum, was made. The shadow was believed to be a fecolith.

On operation it was found that the appendix had sloughed off about 1 cm. from its base, and a fecolith about 2 by 1.5 cm. in diameter was found in a cavity below the cecum between the rectal wall and the right pelvic wall. It appeared as if the fecolith might have been formed by leakage from the appendix stump, which was still patent.

CASE 2.—D. S., a girl 2 years of age, was referred to St. Luke's Hospital by Dr. J. F. Bell, of Englewood, N. J., with a diagnosis of acute appendicitis. A Roentgen examination made for the purpose of excluding the possibility of a right side central pneumonia (two previous cases of this nature having come under our observation) disclosed a shadow in the appendix region and no pneumonia. Operation revealed an acutely inflamed, gangrenous appendix containing a concretion corresponging in size to the shadow on the Roentgen plate. Roentgen examination of the removed appendix further confirmed the identity of the shadow.

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CLINICAL DIAGNOSIS OF LITHIASIS OF THE UPPER URINARY TRACT

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If in this symposium the word "clinical" is to be used in distinction from "roentgen-ray" diagnosis, I shall have to throw up the sponge at once, because the absolute diagnosis of stones in the kidney or ureter without the use of the roentgen ray is impossible. A stone may be present anywhere in the upper urinary tract, either without giving any sign or symptom of its presence, or on the other hand, it may present any of a great variety of signs and symptoms such as would point to any of the various urinary troubles, or even such as would strongly suggest a diagnosis far removed from the urinary tract. Then again, a patient may present what we have been pleased to call a "typical" story of renal colic, bladder irritability, etc., and even show pus and blood in the urine, and yet no stone be present. This is nicely shown in a table by Eastmond as given by Keyes. In a series of eighty cases, sufficiently suggestive of stone to require roentgenographic examination, only twenty-three were positive, and of these, only eight patients complained of the so-called typical symptoms. On the other hand, of the fifty-seven which showed no stone, forty-four did have typical symptoms and in addition, thirty showed either pus or blood, or both, in the urine. In fact, according to this table, there is a better chance of finding a stone if the symptoms are indefinite than if they are typical, as only 24 per cent.

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of the latter had calculi, while 40 per cent. of the former were positive.

In a recent study by O'Neil of 273 cases in the Massachusetts General Hospital in which a preliminary diagnosis of nephrolithiasis was made, the same discrepancy was revealed between the original diagnosis and the real lesion. One hundred and thirty-three of these were house patients, and of this number, twenty-eight were proved to have no stone. Of these, no diagnosis could be made in four cases. The remaining showed a variety of lesions: Hydronephrosis, kinked ureter, movable kidney, and pyelitis were present eight times, while nephritis, appendicitis, gallstones, arteriosclerosis, abdominal glands, vesical calculus and chronic lead poisoning accounted for the rest. Of the 140 cases which got no farther than the outpatient department, more careful study showed only twenty-five with positive findings. The final diagnosis in the remaining 115 cases was as follows: Orthopedic lesions, such as back strain and sacroiliac strain, accounted for thirty-six; no demonstrable lesion could be found in seventeen; genito-urinary lesions, including nearly every diagnosis, covered twenty-seven, while the rest were scattered far and wide from constipation to syphilis, and from hernia to tabes. Nearly every one who has written anything on this subject gives the same story.

From these two tables it seems that symptoms in themselves are merely suggestive at best and may even be misleading. A careful urinalysis likewise may lead us astray, but almost always in one direction. The presence of abnormalities may suggest a urinary lesion which is really not present, but a persistently normal urine in the presence of stone is more uncommon, although still to be reckoned with. In 150 cases in which the urine was carefully examined, Cabot reported persistently negative findings in twenty-one; of these, fifteen were ureteral stones and six renal. It seems almost needless to emphasize the fact that

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in the female, only a catheter specimen has any value, and that a centrifuged sediment should always be examined even in the absence of albumin.

A good roentgenogram is at the same time our best evidence as to the presence or absence of a stone, and likewise the stumbling block most likely to lead us into trouble, for implicit faith in roentgenography, without the confirmation of other means of diagnosis, will often carry us into needless, even disastrous operations; for the misleading evidence most often presented is the presence of a shadow very suggestive of stone, but which in reality has nothing to do with the urinary tract. The percentage of failure to show a stone which is present is very small if the case is in the hands of a good man, and is variously stated to be from 6 to less than 1 per cent. If the roentgenogram reveals a shadow which, in view of other attendant signs and symptoms, probably represents a stone, it still must be proved by means of stereoscopic plates taken with an opaque catheter in the ureter. A single plate is of value, but occasionally a calcified gland may lie in front of the ureter or kidney in such a way that without stereoscopic plates we cannot discover that it is not at all connected with the urinary tract. If the shadow is in the kidney region, two plates taken, one during quiet expiration and the other at the end of forced inspiration, answer much the same purpose.

If the ureter catheter meets an obstruction in the ureter at a distance from the bladder corresponding to the distance on the plate, and other characteristic signs and symptoms are present, the diagnosis is almost certain, but not quite. Cabot speaks of two cases in which a tuberculous gland in the mesentery of the large intestine caused pressure on, and obstruction to, a ureter with dilatation above. In such a case, stereoscopic plates and obstruction to a catheter will fail to make the diagnosis. The use of a wax-tipped catheter, in the hope that any stone present will make its mark, is likewise doomed to failure. But the injec-

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tion of the ureter above the obstruction, and the demonstration of a dilatation, will show the need of operation to relieve pressure, and in spite of our inability to make an absolute diagnosis in these cases, we are consoled by the thought that operation is necessary. In case a stone is in that portion of the ureter opposite the sacro-iliac joint, it has been demonstrated by Dodd and Cabot that it may fail to show in the roentgenograms even though it is of considerable size and density. In these cases, a careful study with the wax-tipped catheter is necessary, and likewise an injection of the ureter above the obstruction is often of value, provided the obstruction is not too great to allow the passage of fluid. The latter procedure, which was condemned as being unsafe a few years ago, is today rendered nearly if not quite harmless by the use of either silver iodid emulsion or thorium. There is finally a small group of patients who have suggestive symptoms, a roentgenogram showing a shadow which might be a stone low in the ureter, with a normal or only slightly abnormal urine, and a ureter opening which will not admit a catheter. Cabot reported two such cases, and I have seen one since. In the last case, I cut the ureter opening freely with the operating cystoscope and still failed to get a catheter in more than a quarter of an inch. A wax-tipped catheter showed no marks, but as I have, on other occasions, failed to get anything conclusive when the catheter met a stone head on, I did not consider it good negative evidence. Operation failed to show a stone, and though some stenosis was apparently present, it did not seem enough to have entirely blocked a ureter catheter, or to have caused the symptoms.

With a shadow in the kidney region, the wax-tipped catheter is still less to be depended on, since a stone in any one of the lower calices will not be touched by a catheter, and accordingly no record will be left on the wax.

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Some authors speak of the use of collargol injected into the pelvis and rendering visible a stone previously invisible. Although I have tried this method, using silver iodid emulsion instead of collargol, and have seen it tried several times, I have never seen it work.

Thus we see that in order to make an accurate diagnosis even of the presence or absence of a stone, we must use all the means at our command; but when we have done this, it is not enough, for the best interest of the patient demands that we should likewise find out the following facts: (1) the presence or absence of another kidney together with its functional ability; (2) the amount of damage done in the kidney having the stone, and (3) the position of the stone in the kidney. In order to do this, the use of other tests, as well as those already spoken of, is necessary. Urinalysis will disclose the presence or absence of any gross damage by its appearance, odor, amount of pus and albumin, and a stained sediment and culture will reveal the type of infection, if any. As stone and a negative urine are perfectly compatible, the presence of the latter is of value only in showing the absence of any damage or infection.

Cystoscopic examination will reveal the presence of another ureter opening which is functioning, and the passage of a catheter will allow the demonstration of the presence or absence of infection and the functional capacity of the well kidney. It is often important, especially in those cases in which previous examination indicates that operation is going to be difficult, to know as accurately as possible in which calix the stone is situated. This can be told very well by having one roentgenogram followed immediately by another, without moving the patient, and with the pelvis injected for the second picture. The second roentgenogram gives us also valuable information as to the amount of destruction of the kidney that has taken place. In fact, it may be the only thing which gives us a real indication of this damage. For even a large

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calculus pyonephrosis may not show on urinary examination the amount of pus we should expect, and because the presence of a stone can cause a reflex inhibition on the functional capacity of the kidney, a very low red test cannot always be relied on to prove the amount of damage it suggests. But when a roentgenogram reveals several stones at the lower pole of the kidney and then a second roentgenogram with the pelvis injected shows not only a grossly dilated lower calix but also a thinning of the cortex at the upper and middle calices, we may consider a nephrectomy the probable operation of choice. In those cases which present a single calix much enlarged and the cortex over it thinned as shown by the roentgenogram, with pelvis injected, we can be confident that a small nephrotomy opening will be our best mode of operation. But even with these procedures, a sufficiently accurate diagnosis as regards the condition of the kidney cannot be made to justify our promising to take out the stone and leave the kidney, as I have had one or two patients demand. Since a destroyed kidney may shut down around a single large stone, not only is the amount of pus very small, but the roentgenogram with injected pelvis discloses no gross dilatation of the pelvis, even though it is absolutely abnormal.

DIFFERENTIAL DIAGNOSIS

In the genito-urinary clinic of the Massachusetts General Hospital, it is fairly common for a patient to be referred with diagnosis of stone, with pain or colic typical in character and with pus and albumin in the urine, whereas a careful examination reveals tender, distended, nodular, seminal vesicles, no pus from the kidneys, and a negative roentgenogram. Treatment of these vesicles cures the stone. Two or three patients have volunteered the information when a finger was pressing on the vesicles, that "there is the pain now." I thought this was conclusive until a short time ago

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when I examined a patient who volunteered such a statement and found on roentgen-ray examination the shadow of what proved to be a large ureteral stone about half an inch from the bladder opening on the side corresponding to the one tenderest on pressure. Generally the colic of seminal vesiculitis is lower down in the back than the renal colic, and follows the crest of the ilium in a more characteristic fashion.

From a review of these cases of mistaken diagnosis it is evident that the appendix has been the greatest sufferer when error has been made. That a certain number of appendixes must inevitably be sacrificed in case of doubt is due to two facts too well known to require comment: 1. An acute suppurating appendix may be present without a corresponding amount of tenderness and rigidity. 2. A considerable amount of microscopic blood may be present in the urine, due to the pressure of an acutely congested appendix on the ureter. In cases of doubt, therefore, the appendix should be removed if for any reason it is not possible to take the time, or the apparatus is not at hand, to make a more accurate diagnosis. I have recently known a case in which a very good surgeon did delay operation in case of doubt with a resulting fatal peritonitis, so that I am sure it is much better to take out an innocent appendix than leave a guilty one. But the same thing cannot be said for other intra-abdominal lesions which do not require an immediate decision, and certainly it seems not only inexcusable but almost criminal to subject any person to operations such as are shown by the following two cases. The first patient, who showed five stones in the right kidney, had at the first operation a dilation and curettement. At the second operation the right ovary was removed and at the third operation the left ovary was removed. The second patient had (1) an operation for gallstones, though the gallstones were not found; (2) an appendectomy and a resection of the right ovary, and (3) a ventral fixation of the uterus. Not until eight years

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after the first operation was it discovered that a stone only three-quarters inch in greatest diameter was blocking the right ureter.

The cases that are complicated by orthopedic lesions are among the most interesting and likewise the most difficult to straighten out because it is seldom that an orthopedic surgeon cannot find postural strain, ptosis, or flatfoot; but whether the real diagnosis be urinary or orthopedic the patients may present themselves to either surgeon.

In the series of cases at the Massachusetts General Hospital previously spoken of, thirty-six cases in which the first diagnosis was renal stone showed orthopedic lesions, of which postural strain and abnormality of the fourth and fifth lumbar vertebrae made up fourteen, the remaining being spread among flatfoot, ptosis, scoliosis, hypotrophic arthritis of the spine, back strain and sacro-iliac strain. In four of these cases the urine was remarkably abnormal; in spite of a negative roentgenogram it seemed difficult to attribute all of the trouble to the orthopedic diagnosis, and it was thought possible that a small stone had been present and passed before the patient was seen. In twenty-four cases there were urinary symptoms, and of these cases the urine was normal in fifteen, so that nothing in the urinary tract could have been the cause of these symptoms. Moreover, some of these patients were relieved of their urinary difficulties when their orthopedic troubles were corrected. The relation between an abnormality of the back and urinary frequency is not at all understood and, indeed, very seldom recognized; but it certainly does occur, and when accompanied by pain and perhaps a suspicious roentgenogram it may lead us far astray. The following case is a good example: Miss X came for relief of urinary frequency and pain low in the left side, sometimes coming on in attacks. A diagnosis of ureteral stone had been made but never proved. The urine was normal; cystoscopic examination

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revealed a slight reddening around the left ureteric orifice, and the ureter would admit only a No. 5 catheter, but that perfectly freely. No stone could be demonstrated. The orthopedic consultant found marked postural strain, and after the use of proper support and exercises, the frequency and pain both disappeared.

CONCLUSIONS

No single piece of evidence, or combination of evidence, is sufficient to make an absolute diagnosis of a renal or ureteral stone. All chance of mistake should be excluded by using ureter catheters, wax-tipped catheters, stereoscopic plates, and roentgenograms with injected pelvis.

In all cases with indefinite symptoms, such as recurrent or chronic pain in the abdomen or back, even when a definite orthopedic abnormality is present, careful, repeated examination of the urine should be made, including a microscopic examination of centrifuged sediment, regardless of the presence or absence of albumin. In the female, such examination is of value only when the urine is obtained by catheter. Whenever operation is considered in any one of this group of cases, roentgenoscopy in addition to the foregoing examination is necessary.

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A CLINICAL STUDY OF LITHIASIS

BASED ON A SERIES OF ONE HUNDRED AND NINETY-EIGHT CASES

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In urinary lithiasis our plan of action depends entirely on an analysis of the individual case, and the degree of our success in the treatment will be proportionate to the completeness of our understanding of the pathology presented.

An analysis of 198 cases which I have studied in hospital and private practice forms the basis for certain deductions relative to the formation of urinary calculi, the clinical picture presented, and a general outline of treatment.

Of the 198 cases, 111 were in males, 87 in females. Excluding the cases of calculi of the lower urinary tract, 12 of which occurred in females, there were 73 males and 77 females with calculi of the upper tract.

These figures are at variance with recorded statistics. The usual larger proportion of males is probably due to the fact that more women with urinary symptoms consult the gynecologist than the urologist, and a fair comparison could not be obtained.

INCIDENCE ACCORDING TO AGE

Age of Patients	No. of Cases
1 to 9 inclusive	1
10 to 19 inclusive	3
20 to 29 inclusive	32
30 to 39 inclusive	55
40 to 49 inclusive	43
50 to 59 inclusive	29
60 to 69 inclusive	28
70 to 79 inclusive	5
80 to 89 inclusive	2
Total	198

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The relatively large number of patients past middle life presented vesical calculi.

In the formation of urinary calculi, two predisposing factors have stood out most prominently. These are (1) a gastro-intestinal disturbance, and (2) disturbed drainage along the urinary tract. The question seems to be more one of body elimination than one of intake.

The most important pathologic condition of the gastro-intestinal tract in this relation to lithiasis is some degree of stasis. The causes of stasis can be ascertained only by a study of the entire alimentary tract.

Through intestinal stasis, the chemistry of the blood supplied to the kidney is altered and bacteria in large numbers enter the urinary tract.

The effect of disturbed drainage of the urinary tract is most easily studied in the bladder. The rapidity with which decomposition takes place and calculi form when residual urine accumulates, we have all noticed in cases of vesical obstruction with retention. There is no reason why the same action does not take place in the kidney.

Interference with kidney drainage is most often due to abnormal mobility. The mobility may be slight and still cause a kinking at the ureteropelvic junction if the ureter is fixed. Of the 77 females showing calculi of the upper urinary tract, in 51 the calculi were on the right side, in 22 on the left, while 4 were bilateral. In 39 of the right-sided cases, and 11 of the left-sided, a certain degree of mobility, interfering with drainage, could be demonstrated.

As all ureteral calculi are probably renal in origin, they may be grouped together in this consideration.

In the males, twenty-eight were right-sided, thirty-eight left-sided, and five bilateral. Unfortunately, in but few of these cases was the renal mobility ascertained, but in several it was strikingly marked. One patient presented a pelvic kidney, and several others

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showed a well-marked prolapse. Abnormal mobility will no doubt be demonstrated more frequently in males if more careful examinations are made. Palpation which fails to reveal the lower pole of the kidney on deep inspiration does not exclude this possibility. Better muscular development in the male interferes with palpation. Recently, during the examination of a patient, a kidney which could not be palpated on deep inspiration dropped to the brim of the pelvis while the patient was standing erect.

Three patients with renal calculi gave a history of injury. One patient presented a calculus with hypernephroma.

The symptoms presented by renal calculi may be of so slight a nature as to pass unnoticed for many years, as in the following cases:

CASE 1.—A man, aged 33, had had a vesical calculus removed three years previously. He came for consultation for vesical irritability, suspecting another vesical calculus. Investigation disclosed a branching calculus completely filling the pelvis and calices of both kidneys. The patient positively refused operation, saying he had had no pain or discomfort.

CASE 2.—A woman, aged 65, entered the hospital with the diagnosis of appendicular abscess. A definite mass was palpable in the lower right quadrant. An examination of the bladder revealed an obstruction of the right ureter with thick pus. On dislodging the plug in the ureter, and by gentle pressure on the abdominal mass, 16 ounces of thick, foul-smelling pus were evacuated through the cystoscope. Exploration of the abdomen showed a calculus the size of an orange in a shell of a kidney.

How long the calculus had been present in these cases, and in many similar ones, one cannot say. I recently removed a calculus from the left kidney pelvis of a man, aged 34, who was sent to me to be treated for a chronic urethritis. There were no symptoms referable to the kidney, although the kidney pelvis was so surrounded by lymph exudate and fat that the calculus resembled the stone in the center of a peach. The vesical irritability entirely disappeared after the removal of the calculus.

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Pain is the most constant symptom of renal calculus, and was present in some form in thirty-five of forty-three patients. In renal calculi the pain was never severe, except when the calculus was small and located in the pelvis or in a calix, so as to interfere with the urinary flow, thus increasing intrarenal tension.

A dull ache localized in the costovertebral angle was the most typical symptom, but was not constant, and was evidently due to local infection. Radiation along the course of the ureter was present in seven cases in which the calculus was located at the ureteropelvic junction. Other radiations noted were to the opposite kidney region, chest, right lower quadrant, testes, thigh, and entire back. Invariably the larger the calculus, the less severe the pain, and in eight cases only vesical symptoms were present. In four of these cases the kidney had gone on to almost complete destruction. Tenderness in the costovertebral angle or anteriorly in the right upper quadrant was elicited in thirty-two case, and the kidney was palpable in only eighteen. Roentgenograms were positive in all but two of the cases of renal calculi. In these two a diagnosis of an obstruction at the ureteropelvic junction was made, and at operation a calculus was found. The character of the urine was found in sixteen cases to be of no aid in establishing a diagnosis of renal calculus, while in the remaining twenty-seven cases blood and pus cells were found in varying quantities. Profuse hematuria was present in four cases. Colon bacilli were found in thirty-one cases, staphylococci in four. In two bilateral cases the entire renal cavity was filled with phosphatic deposit.

If a calculus does not increase in size too rapidly, it passes from the kidney into the ureter, and in its passage through this channel may give rise to a clear-cut picture of renal colic, or to a greater variety of symptoms than any other abdominal condition.

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Of 150 cases of calculi of the upper urinary tract, 107 were ureteral calculi, and while they were found lodged at almost every point, from the ureteropelvic junction to the vesical orifice of the ureter, eighty-six were lodged in the lower 12 centimeters, and sixty-five of these in the last 6 centimeters. The symptoms in these cases extended in duration from a few hours to fifteen years.

The young woman whose condition is next described furnishes a typical case.

CASE 2.—A woman, aged 21, twelve hours before admission to the hospital, was seized with a sharp pain in the right lumbar region, accompanied by vomiting and shock. The pain soon radiated to the groin. The following morning the pain was most severe in the right lower quadrant, and there was an urgent desire to urinate. Urine was scanty. Examination of the bladder revealed edema about a functionless right ureteral orifice. A ureteral catheter encountered an obstruction 2 cm. from the bladder. A roentgenogram revealed the catheter in contact with a small shadow. The ureter was dilated and a small calculus removed with ureteral forceps, with complete relief and no return of symptoms.

CASE 3.—A woman, aged 44, for fifteen years had had pain in the right side of the abdomen, not localized. She complained of indigestion, constipation, flatulency, painful menstruation, and frequent burning urination. She had had a nephropexy, an appendectomy and a ventral suspension; the right ovary had been removed, the bladder irrigated, and medical treatment given, with no relief. Investigation showed a calculus lodged in the right ureter, at the pelvic brim, with pyelonephritis. Removal of the calculus gave partial relief of symptoms.

Between these two extremes were all types and degrees of abdominal symptoms, but pain was a fairly constant factor in all cases of ureteral calculi.

Eighty-six of the 107 cases of ureteral calculi gave a history of pain on the affected side, 4 of referred pain on the opposite side, 65 had a definite colic, and 45 had had from two to eleven attacks; 35 gave a history of having previously passed calculi.

Of the 65 cases of calculi lodged in the last 6 centimeters of the ureter, 56 complained of urinary symptoms.

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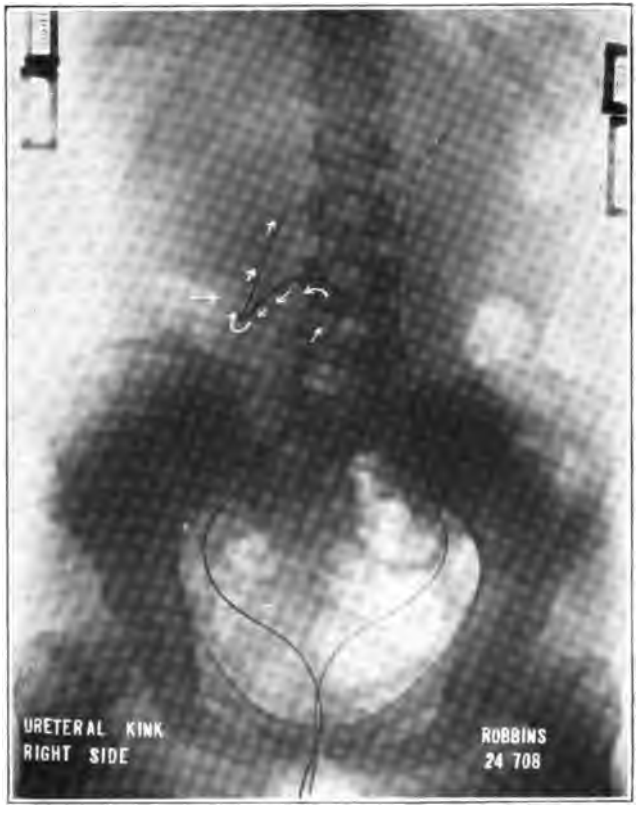

Fig. 1.—Sharp kink in right ureter, demonstrated by roentgen-ray bougie which has been softened by boiling. (A stiff bougie would not pass through this kink, and distention of the ureter with thorium would tend to straighten out the ureter.) Roentgenogram by Dr. L. T. Le Wald.

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Fig. 2.—Complete loop in ureter, forming obstruction, demonstrated by soft ureteral bougie. Roentgenogram by Dr. L. T. Le Wald.

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Fig. 3.—Sharp kink in ureter, demonstrated by soft ureteral bougie. Roentgenogram by Dr. L. T. Le Wald.

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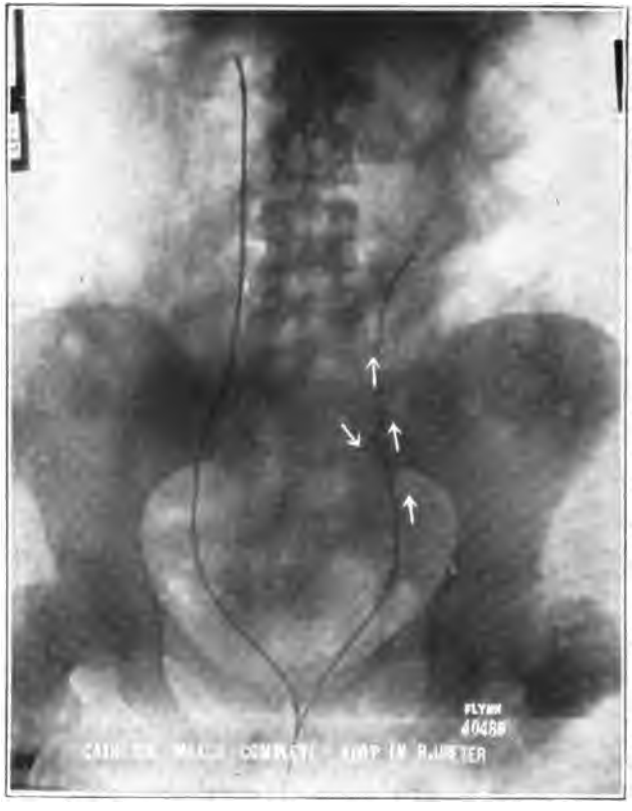

Fig. 4.—Diverticulum of ureter following operation for ureteral calculus, demonstrated by soft ureteral catheter, which forms a complete loop in the diverticulum. Roentgenogram by Dr. L. T. Le Wald.

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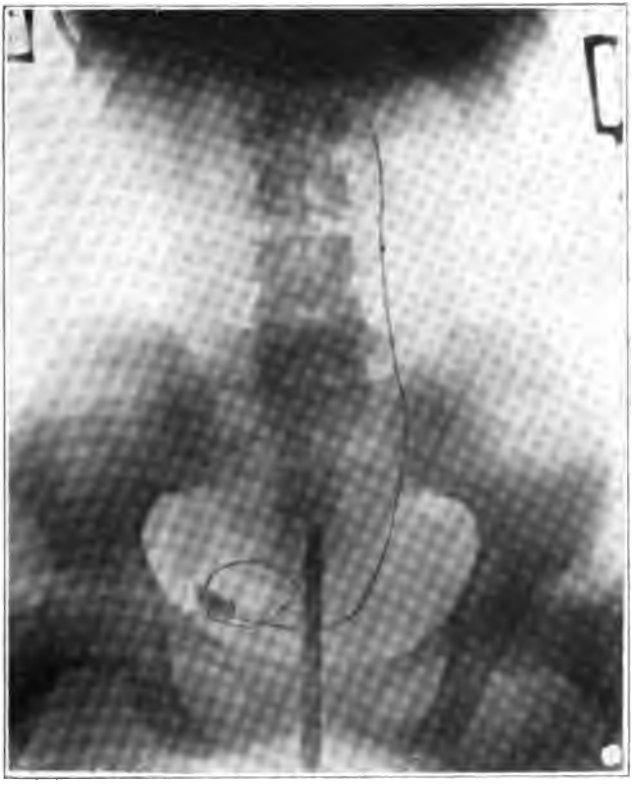

Fig. 5.—Soft ureteral bougie encircling ureteral calculus lodged 3 cm. from bladder. Roentgenogram by Dr. L. T. Le Wald.

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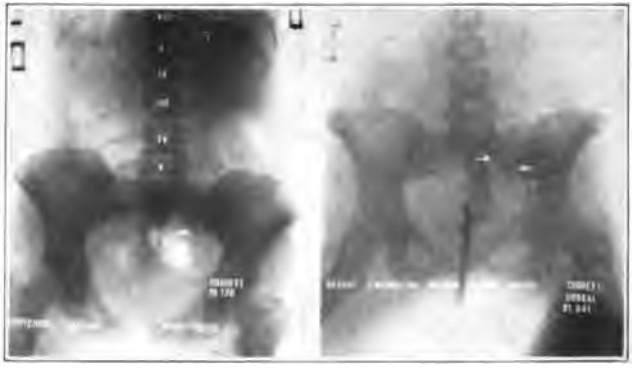

Fig. 6.—Soft ureteral bougie encircling lower end of calculus at ureteropelvic junction. Roentgenogram by Dr. L. T. Le Wald.

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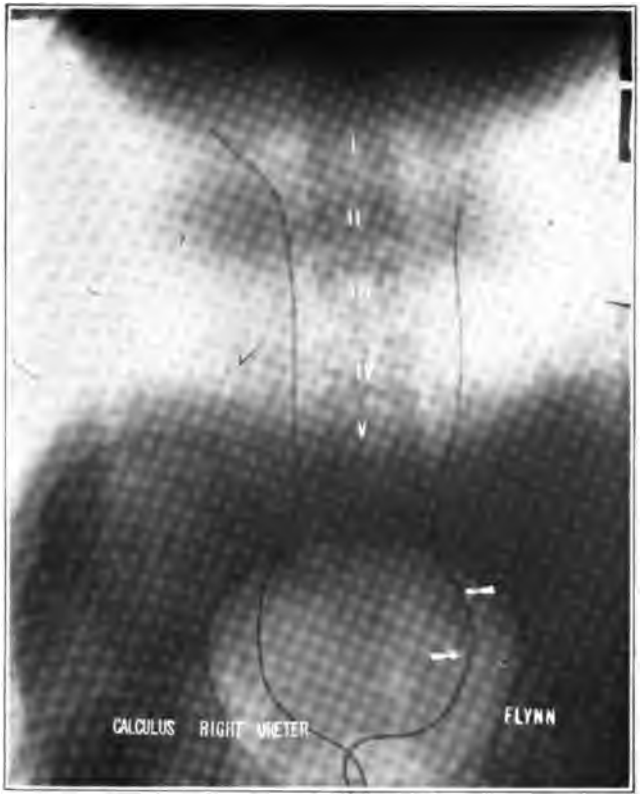

Fig. 7.—Calculus in ureter lying in contact with ureteral catheter. (Calculus shown in Figure 15 removed by traction method.) Roentgenogram by Dr. L. T. Le Wald.

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Fig. 8.—Soft ureteral bougie, demonstrating course of ureter, with patient in dorsal and standing positions. Ptosis of kidney. Roentgenogram by Dr. F. M. Law.

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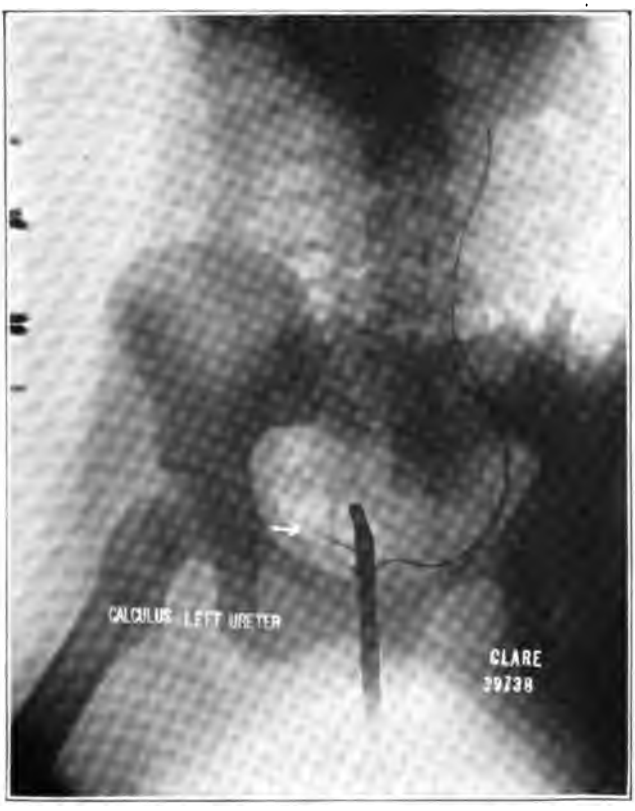

Fig. 9.—Soft ureteral bougie in contact with calculus in ureter. Roentgenogram by Dr. L. T. Le Wald.

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Fig. 10.—Soft Ureteral bougie: (1) confirming the diagnosis of ureteral calculus; (2) demonstrating position of calculus after dilatation of ureter; (3) showing ureter free from calculus. Roentgenogram by Dr. L. T. Le Wald.

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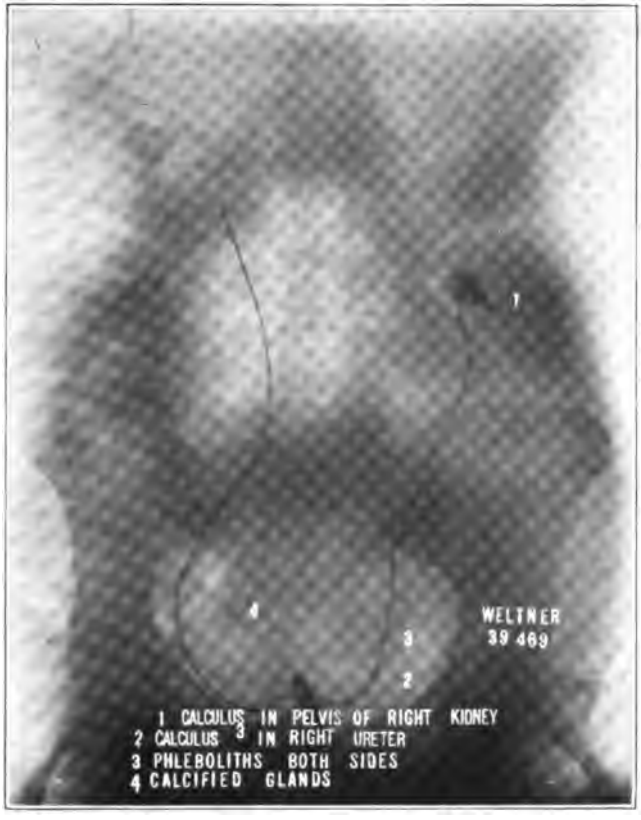

Fig. 11.—Stereoscopic roentgenogram of urinary tract, with soft ureteral bougie and catheter in position, demonstrating their value in confirming or eliminating shadows along this tract. Roentgenogram by Dr. L. T. Le Wald.

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Fig. 12.—Soft ureteral bougie in contact with calculus in pelvis of pelvic kidney. (Thorium injections failed to demonstrate the lesion.) Roentgenogram by Dr. L. T. Le Wald.

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Fig. 13.—Soft ureteral bougie encircling calculus in pelvis of kidney. Roentgenogram by Dr. L. T. Le Wald.

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Fig. 14.—Soft ureteral catheter in contact with calculus in pelvis of kidney. Roentgenogram by Dr. L. T. Le Wald.

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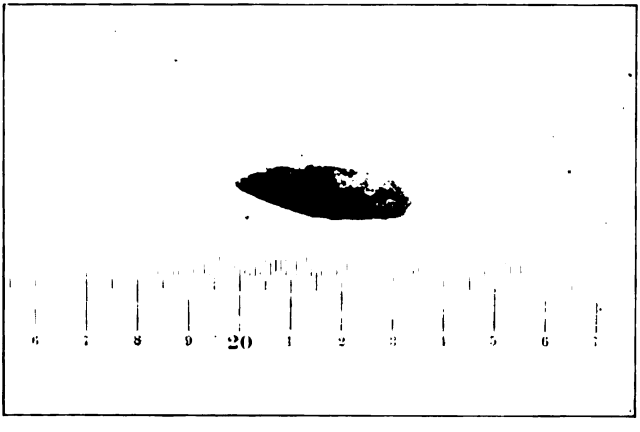

Fig. 15.—Ureteral calculus removed by coiling soft bougie about it while in the position shown in Figure 7 and applying traction.

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Cystoscopic examination revealed the calculus lodged in the mouth of the ureter in 4 cases. Edema about the orifice was present in 47 cases. A deflection of the stream of urine from the ureteral orifice was noted in several cases in which the calculus was lodged in the intramural portion of the ureter. The urine showed pus cells or blood cells in 81 cases; was normal in 22 cases. Crystals were noted in 18 cases; colon bacilli showed a growth in 62 of 78 cases in which a bacteriologic examination was made.

In 75 per cent. of the cases a definite obstruction, partial or complete, was evidenced by passing ureteral catheters and bougies. In 11 cases the calculus could be located by palpation through the vaginal vault and in four males by rectal palpation.

No roentgenograms were taken of 16 patients who passed calculi subsequent to the cystoscopic manipulation. In the remaining 78 cases a roentgenogram was made with opaque catheters or bougies in position. A positive plate was obtained in 56 cases. The 22 patients not showing a shadow passed calculi following manipulation. These calculi were all small, and were either phosphatic or uric acid stones. A collection of crystals causing a definite colic was present in six cases. A complete obstruction was encountered in each case, and was relieved by intra-ureteral manipulation.

I have made it a practice for the past five years to boil the catheters and bougies, thus rendering the bougie soft enough to pass through almost any kink, or to coil about a calculus. Often the tip of the bougie is bent so that it is hooked, and by passing the bougie, twisting it as it advances, the calculus, which would often otherwise be passed by, is encircled by the bougie. In this manner, with stereoscopic roentgenograms to eliminate extraneous shadows of phleboliths, calcareous glands, atheromatous patches, enteroliths and gallstones, a diagnosis may be made in two thirds of our cases. In the remaining third, a ureterogram,

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the calculus being coated with collargol, or the employment of wax-tipped catheters, may be necessary, and all methods may be negative.

I have no doubt that in some of our cases which were passed by as negative, with ureters free to a No. 7 F. catheter, with negative urine and roentgenograms, a calculus may have been lodged in a sacculation of the ureter which has since caused symptoms. I am inclined to believe that the wax-tipped catheter should be used more frequently in these negative cases, and it is wise to have all patients report for subsequent examination.

A differential diagnosis between ureteral kinks, urinary tuberculosis, renal tumor, and stone often may be difficult, and may be made only by repeated examinations.

Calculi in the lower ureter may cause symptoms so like appendicitis that it has almost become routine to pass a ureteral catheter in all cases of right-sided pain. Pelvic disease and acute intestinal lesions in connection with calculus in the lower ureter, gallstone colic, acute gastric and intestinal conditions, must be excluded in calculi lodged in the upper ureter and kidney. This should always be possible with the means at hand, although the possibility of the presence of more than one lesion should be borne in mind.

The treatment of calculi of the upper urinary tract can now be laid down on definite principles.

A renal calculus remains in the kidney and increases in size, acting as a menace to the kidney and to the patient, or it passes into the ureter. If it remains in the kidney it should be removed, unless there is contraindication to operation from the condition of the patient, or of the opposite kidney, and the sooner it is removed the better. By its remaining, more or less of the kidney will be ultimately destroyed. When the kidney destruction is advanced, as proved by pyelogram and functional tests, or when many calculi are present throughout the kidney, a nephrectomy may be

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necessary, as in four of the cases of this series. In cases of large branching calculi the kidney may have to be split, as in two cases. The remaining cases can be relieved by pelviolithotomy.

If the calculus passes into the ureter, and does not enter the bladder after manipulation with ureteral catheters, bougies, and dilatation of the lower ureter, it should be removed. That the majority of ureteral calculi will pass, certainly after manipulation, is proved by this series. Ninety-two of 107 calculi lodged in the ureter were passed subsequent to or removed by cystoscopic manipulation. Only fifteen were removed at operation.

Calculi should not be allowed to remain in the ureter too long. Stricture of the ureter, or damage to the kidney from back pressure and infection, will often be the result. The sooner the patient is seen after the initial attack of colic, the better the chance of assisting the passage of the stone.

While all methods of manipulation and injection have been applied, dilation of the lower ureter and manipulation of the calculus with catheter and bougies, in an attempt to loosen and change the axis, was deemed of advantage. There is no doubt that this is worth repeated attempts. Several calculi have been followed with roentgenograms in their descent after manipulation, showing the advance of the calculus with each attempt. This process has been repeated as many as eight times, but the first few attempts will usually be successful if the calculus is going to pass. An attack of colic is often brought on at the end of the manipulation, and denotes that the calculus has shifted its axis and is obstructing the ureter. Large quantities of water will supply the pressure above, and the stone will be passed.

A method which has proved successful, even in as large a culculus as the one exhibited (3.5 by 1 cm.), is to hook the end of the ureteral bougie and twist the bougie as it is advanced along the ureter, coiling it about

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the calculus and then applying traction. A calculus was extracted two weeks ago in this manner. This patient had undergone a ureterotomy for a calculus one quarter the size, lodged at the pelvic brim. A fistula resulted which healed only after inserting an indwelling ureteral catheter, which was left in position for ten days. A diverticulum formed at the point at which the calculus had been lodged. Twelve calculi have since formed in this pouch, descended into the lower ureter, and have been extracted with ureteral forceps, or passed after intra-ureteral manipulation.

How large a proportion of these ureteral calculi would have passed had nothing been done, it is impossible to say; but it is probably fair to assume that 50 per cent. would have been recovered. Only six patients giving a history of ureteral colic, negative at examination, returned with a history of subsequent attacks and passing a calculus.

Fifteen of the calculi removed at operation were approached extraperitoneally, and one transperitoneally.

There were two deaths out of the forty-three patients operated on for renal calculi, both caused by uremia, in bilateral phosphatic calculi. The operation in each instance was undertaken against advice. One patient with ureteral calculus died six weeks subsequent to operation. The cause of death could not be ascertained.

In this review of 198 cases of lithiasis, several points are worthy of note with regard to the forty-four cases of vesical calculi. A definite history of renal colic, with relief of pain without passing the calculus, was given in fourteen cases, and in the remaining thirty it was found that the bladder was the seat of an infection and was carrying residual urine. The cause of the retention was prostatic obstruction in the males, and cystocele in the females —a rather convincing argument that infection and

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urinary stasis play an important rôle in their formation.

The diagnosis of vesical calculus should be simple. Seldom is it impossible to pass a small cystoscope into the bladder and make a diagnosis by sight. A roentgenogram, in the absence of a cystoscopic examination, is often sufficient.

Of the forty-four cases, the calculi were crushed and evacuated in thirty-three, and removed by cystotomy in eleven cases. Litholapaxy is still an important procedure in cases not requiring an operation on the bladder or prostate, and when supplemented by the use of the cystoscopic lithotrite, should be the method of choice more often than it is.

Prostatic calculi, the result of long-standing prostatic infection, were found in three cases. The diagnosis was easily made by palpation. Undoubtedly they are occasionally overlooked, the diagnosis of malignancy being made. More frequent roentgenograms in patients giving prostatic symptoms of long standing might disclose more cases of prostatic calculi. The treatment is by prostatectomy.

One case of calculus in the seminal vesicle was noted, and a renal calculus with a clear history of colic followed by retention showed the calculus lodged in the prostatic urethra. This was dislodged with forceps applied through the endoscopic tube, and was passed by the patient.

RECAPITULATION

Intestinal stasis is an important predisposing factor in the formation of urinary calculi. Urinary stasis and infection are immediate predisposing factors. Renal mobility plays an important rôle in this consideration.

Renal calculi may be single or multiple; small or large; unilateral or bilateral; located in the cortex, the pelvis or a calyx; or they may be branching, completely filling the cavity of the kidney.

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Local symptoms may be absent, slight, or acute. Physical signs may be absent or definite. A diagnosis of the presence of a calculus should be made by cystoscopic and roentgenographic methods. Contact of the tip of a roentgen-ray bougie will verify the diagnosis in many cases of renal calculi, but may have to be supplemented by pyelograms, not only to locate exactly the stone in the kidney, but also to show the extent of kidney destruction. Data so obtained make it possible to outline the operative procedure which will result in a cure, and after-care may prevent recurrences.

Ureteral calculi are common. They may give rise to indefinite abdominal symptoms, or to typical colic. Fifty per cent. of ureteral stones will pass; 75 per cent. will be passed following intra-ureteral manipulation, which consists in dislodging the calculus and dilating the ureter below.

Vesical calculi are comparatively rare, owing to earlier diagnosis and the better treatment of vesical obstructions. When found, they are smaller than formerly, owing to the earlier diagnosis, and can often be removed by litholapaxy, unless a prostatectomy is necessary.

Prostatic calculi should be suspected in long-continued prostatic suppuration. They should be diagnosed early and removed by prostatectomy.

40 East Forty-First Street.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. CALDWELL, LE WALD, E. L. YOUNG, JR., AND BUGBEE

Dr. Henry K. Pancoast, Philadelphia: After Dr. Caldwell's numerous references to the unquestioned value of the roentgen diagnosis of urinary calculus, all must agree that a roentgenographic study should be made in every case in which calculus is suspected. A careful examination should be made of the entire tract, for the reason that a stone may not be where it is suspected, may be on the side opposite to the symptoms, or there may be calculi on both sides. In the second instance the stone may not be found, and in the

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third, the patient's life may be endangered by operation if only one kidney or ureter has been examined. Even though a calculus shadow is found only on the side opposite to the symptoms, a small uric acid stone or one hidden by bony structures may be present and missed and be accounting for symptoms.

When one considers the numerous sources of error it is remarkable that the percentage is so small, as Dr. Caldwell has stated. Most of them have already been alluded to in the papers, but a few have not. The most important and most frequent is careless or faulty preparation of the patient. Adequate preparation means the withdrawal of food for nearly twenty-four hours before the examination, complete evacuation of the intestinal tract to eliminate both fecal contents and gas, and the withdrawal of drugs, especially in pill or tablet form. Possibly salol is the worst offender. Of course, foreign bodies in the intestinal tract other than pills form a small percentage of sources of error. Dark moles on the back constitute a well known source. Phleboliths in the pelvic veins are extremely troublesome and cannot always be eliminated even by the ureteral catheter and stereoscopic plates. Calcified mesenteric glands frequently give trouble, especially when near the renal region.

The last essayist mentioned fecaliths, and when these are in an inflamed appendix close to or adherent to the ureteral region they may be misleading clinically and roentgenographically. In one instance a dermoid cyst containing a single tooth and pressing on and obstructing a ureter led us to a diagnosis of a ureteral calculus because of the tooth shadow in the ureteral line. Finally, many stones, especially uric acid calculi, may be hidden by the bony parts or may not be seen in very stout persons.

Dr. W. F. Braasch, Rochester, Minn.: Because of this obscurity of symptomatology the following rules have been made at the Mayo Clinic:

Roentgen-ray examination is made (1) when abdominal pain is not definitely localized; for example, in the gall-bladder, the appendix or the pelvis; (2) when, though the pain is definitely localized in these organs, there is pus or blood or a past history of pus or blood in the urine, and (3) in the absence of abdominal pain, if there is a past history of pus or blood, or if microscopic pus or blood is found in the catheterized specimen.

The leaded catheter is of value in the diagnosis of ureteral calculus only when the calculus is 2 cm. or more away from it and when it is in close apposition and cannot be passed beyond the calculus. When the leaded catheter is in close apposition to a suspected ureteral shadow it is of little diagnostic value. Nor does a stereoscopic examination help much, because, even though the stereoscopic examination reveals that the leaded catheter is a centimeter distant from

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the shadow, it does not mean that the shadow is extra-ureteral.

In such doubtful cases a more exact method of interpretation is available in the ureterogram. This method should be employed only when others have failed, and when the introduction of the catheter is not obstructed. The use of the ureterogram is restricted because the procedure is not without danger. Any fluid injected beyond an obstruction, whether it be boric acid solution, silver or thorium, will cause damage to the parenchyma of the kidney unless drained out. If an opaque medium is injected beyond an obstructing stone in the ureter, a great deal of trouble will result in a small percentage of cases, so much so that the kidney may have to be sacrificed. Therefore, a ureterogram should usually not be made unless the catheter can be passed beyond the shadow and the injected fluid can be removed. Of the various solutions, thorium is undoubtedly the best, because with careful technic it can be removed. The catheter should be allowed to remain for a few minutes after washing out the renal pelvis.

Pyelography has also proved to be a valuable method in the diagnosis of shadows situated in the renal area. It may be used more freely in the pelvis of the kidney because the fluid is seldom obstructed by a stone. Further, pyelography is of value not alone in the diagnosis of shadows in the kidney, but also in the localization. Those of you who have had experience in searching for a stone in a large, congested kidney will appreciate any effort made by the diagnostician to localize exactly any small shadow in the kidney.

Dr. Herman L. Kretschmer, Chicago: The stereoscopic pictures with shadowgraph catheters are of value in a certain percentage of cases. The stereoscope will show in a certain number of cases a definite interval between the suspicious shadow and the catheter. I agree with Dr. Braasch that in some cases the stereoscope will not help out. In those cases the ureterogram is in perfect order. In the doubtful cases it would be well to use some silver salt instead of the thorium in making the ureterogram. Kümmel in Hamburg first called attention to the fact that shadows were made more positive by silver salts.

Dr. Bugbee's statement, I think, was a little bit too conservative when he said that about 50 per cent. of these stones can be passed or removed by noncutting operations. The percentage is much higher. Probably all of these ureteral stones which have not remained in the ureter so long as to produce a stricture can be worked down or passed by the use of papaverin and oil injections. Thus far I have been rather successful. The idea of Dr. Bugbee of turning the catheter around the stone and pulling it out is rather unique. I wish in closing he would tell us just how he curls the catheter around the stone.

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The point has been emphasized several times that the entire urinary tract should be roentgen rayed. Frequently patients have just one part of the urinary tract rayed and they are operated on after a diagnosis made from one picture. I have in mind two patients who had been operated on elsewhere and a kidney removed, and they have calculi now in the remaining kidney. It would be interesting to know whether they had bilateral stones in the first place, or whether the remaining stone has formed in the kidney since operation.

Dr. Abraham Hyman, New York: In a series of seventy-four cases of ureteral and renal calculus we have had 10 per cent. of negative roentgenograms. In vesical calculus more than 61 per cent. of the stones failed to show. A large number of these negative roentgenograms were in prostatics, which probably accounts for this high percentage. In thirty-four of the seventy-four cases of ureteral calculus the ureteral catheter was obstructed at the site of the stone, and in 50 per cent. of these cases there was a considerable difference in the output of indigocarmin; it was either absent or considerably diminished.

As regards the wax tipped catheter, it was of considerable value in but one case. In this patient, a rather stout woman, there were three negative roentgenograms. She had pus in the urine and radiating pain in her side. The wax tipped catheter showed distinct scratch marks on two occasions.

During the past few years three patients have been operated on in the service for renal calculus in which most of the findings were considered positive. The Roentgen ray demonstrated distinct shadows in the renal region. Unfortunately, the symptomatology and the ordinary methods of examination were thought to be so characteristic that other methods, such as pyelography, the wax tipped catheter and stereoscopy, were not employed. At operation there was no calculus to be found in any of the three cases. In two, we could distinctly feel retroperitoneal calcified glands which undoubtedly cast the shadows. In the other case the symptoms were found to be due to a twisted ovarian cyst. This was not discovered until the patient returned to the hospital six months later, complaining of the same symptoms. She was operated on and a twisted ovarian cyst was found.

Concerning urinalysis, we have had a few cases of renal and ureteral calculus in which the urine examination was entirely negative—no pus or red blood cells—so one cannot rely absolutely on negative urinary findings.

Just a word in regard to allowing calculi to remain in the ureter too long. We had a patient recently who gave a history of pain in the right loin of two years' duration. She came to the hospital and cystoscopy showed an obstruction low down in the ureter, due to a fairly large sized

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calculus. There was no indigocarmin output and no urine was obtained from this side. The stone was removed by an extraperitoneal ureterotomy and the patient was discharged from the hospital about three weeks afterward. She returned a few months later complaining of the same symptoms. The roentgenogram was negative. She was cystoscoped and on the side where the stone had been a hydronephrosis was found. The pelvic capacity was about 28 c.c. A ureteral catheter was left in the pelvis for about a week and lavage was carried out every other day with silver solution. Cystoscopy about two weeks after this showed that the pelvis had contracted but a few cubic centimeters in capacity. This was verified by pyelography. Her symptoms, however, had abated considerably. I bring this point out to emphasize the fact that in a large percentage of cases in which there is long continued obstruction due to ureteral calculus we will often find a hydronephrosis, which in many instances may not be improved after the stone has been removed.

Dr. James W. Hunter, Norfolk, Va.: As a roentgenologist I have made about 1,200 examinations. Three cases were most remarkable. A man of 45 whose only complaint was night sweats showed no emaciation and had no cough. An examination of his right kidney showed the most beautiful growth of dumb-bell and mushroom kidney stones that I have ever seen and its removal effected a complete cure. A woman presented all the typical symptoms of kidney colic. The kidney was negative, but at the ureteral orifice was found a shadow typically cigar shaped. Cystoscopic examination and the passage of a bougie showed that the shadows coincided. She was operated on by a prominent surgeon and nothing was found. She was examined about a year afterwards in consultation with another surgeon. The same symptoms and the same shadow were found. On operation nothing whatever was found near the ureteral orifice. The ureter was dilated and inflamed. The cigar-shaped calculus was found in the pelvis of the kidney. When the woman was up and about the calculus would descend to the lower end of the ureter, but when she remained in bed it worked back up to the pelvis. This woman is well now.

Dr. H. A. Fowler, Washington, D. C.: It has been definitely brought out that there are no pathognomonic signs or symptoms of stone in the kidney or ureter. A stone may be present in the kidney without giving rise to any symptoms whatever, either on the part of the kidney or of any other organ.

On the other hand, there may be no signs or symptoms referable to the kidney itself, the seat of the disease, but the symptoms are entirely abdominal, or referred to some abdominal organ. This has been shown by the statistics of Braasch and Cabot particularly.

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The demonstration of the presence of a stone in the ureter or the kidney is only the first step in the diagnosis. It is important that the diagnosis should be made complete. That means, first, the location of the stone. Is the stone in the kidney, in the pelvis, in the calices or in the ureter? Is there more than one stone? Is the stone in the upper or lower pole? If we can locate the stone definitely in this way the operative procedure is simplified and the trauma resulting from operative interference is reduced to a minimum. Instead of doing as the general surgeon has been doing in the past, exploring the kidney by making a wide section, if we know where the stone is situated we can make a small incision through the capsule over the stone and extract it through the small incision. This means much less trauma and a much simpler operation.

It has not been my experience to meet with as large as 12 per cent. of cases in which no blood or pus was found on repeated examination of a centrifuged specimen of urine. I was taught to believe that in the majority if not all cases of stone in the kidney or ureter if repeated examination of a centrifuged specimen was made blood would be found, and that has been my experience. I recall only one case, that of a stone in the upper calyx of the kidney, in which repeated examinations failed to show the presence of a few red blood cells. There is no reason to doubt his statistics, but I simply mention my personal experience.

Dr. G. G. Smith, Boston: In regard to Dr. Fowler's point about the presence of blood in the urine, I have lately noticed that in the routine examination of urine specimens from patients in the women's genito-urinary outpatient clinic at the Massachusetts General Hospital we have had an almost constant report of a few red blood cells, and that has happened so often that it has made me feel that in a thoroughly centrifuged specimen examined by a conscientious, thorough house officer a few red blood cells will almost always be found. I should like to hear some opinions on that. Some of these patients whose urine showed the red blood cells certainly had nothing wrong with the genito-urinary tract that we could discover in any other way, and there were too many of those cases showing red blood cells and nothing else for one to say there was a stone which could not be detected.

I have injected papaverin into the ureter once in each of four cases of ureteral calculi. In two cases the calculi were passed two weeks after the injection. The other two patients, the last time I saw them, had not passed their stones.

I think in the treatment of renal stone we are too often concerned with the question of getting the stone out of the kidney and getting it off our conscieuce, as it were. We do not stop to think of the fact that these renal stones recur,

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as Cabot and Crabtree have shown, in about 50 per cent. of the cases, and I think the operation and the after-care of the patient should be directed as much with a view to preventing recurrence as to getting out the stone at the present time. In the case of working people, for example, people who cannot afford to be laid up long and have repeated operations, if one knows one kidney is sound and in the other kidney a good deal of the parenchyma has been destroyed and there is considerable infection, I believe it is better to do a nephrectomy, even though the kidney is worth something, and relieve the patient of the almost certain probability of future trouble. These patients want to be cleaned up so that they can go back to work and never have further urinary trouble. I think that cavities in the kidney, dilated calices, should be obliterated, if possible, at the time of operation. Otherwise calculi will be pretty sure to recur in them. After operation the infection of the kidney should be cleaned up, if it is possible to do so, and I believe in a good many cases one can do that by lavage of the renal pelvis. I believe that the genito-urinary surgeon is negligent who does not follow up his cases after operation and do his very best to clean up, once and for all, the infection which in that particular case is probably a factor and will be a factor in further stone formation. Undoubtedly some cases have what might be called the calculous diathesis; that is, the output of certain chemical substances in the urine is increased. Dr. Young had an interesting case that put out between 6 and 7 gm. of phosphates a day, and under dieting that was reduced to 1.5 gm. There are certain cases of stone formation in the genito-urinary tract which might almost be called malignant. One removes a stone from the kidney and within a year another appears; these stones are often bilateral. In the cases I have studied there are always phosphatic calculi, and if one finds a case of phosphatic calculus one can be sure that is the stone that is most apt to recur. Its recurrence should be prevented by cleaning up infection and by placing the patient on a diet which excludes milk and eggs as far as possible, and, in addition to that, the patient should take a dram of chalk after each meal. That sounds a bit arbitrary, perhaps too empirical, but as far as we know now that is the only method which will lower the output of phosphates. The chalk prevents the absorption of phosphates from the intestinal tract, so there is less phosphatic material excreted by the urine.

Dr. A. M. Wose, Syracuse, N. Y.: Recently six exposures of a calculus in the bladder were made, with negative findings. Examination with the cystoscope readily showed the calculus. This caused a little controversy with the roentgenologist, and in order to appease him I suggested after the extraction of the stone that I would be glad to make a little investigation with this calculus on a plate with the

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electrode at a distance of 18 inches. He did that, with negative findings. After that I suggested that he take a picture of his hand with the calculus on the hand, with the electrode 18 inches above, which he did, and there was no shadow of the calculus. Then I said the investigation ought to be chemical. It proved to be a pure uric acid stone.

Dr. V. D. Lespinasse, Chicago: In this connection I should like to report some work that has a bearing along this line. I started out to determine the changes that occur in the kidney following obstruction from a stone. I found that complete obstruction caused very rapid and severe changes. When the obstruction was partial the changes came on slowly and involved the ureter primarily. From that it was changed over to a clinical problem. By introducing a little stick of wood it was found that we could obtain a dilatation of the ureter, beginning at the lower end, and as time went on, going up to the kidney and ultimately involving the kidney; but it takes from ten to twenty days before any change occurs in the pelvis of the kidney. In that time there will be a dilatation of the ureter to about two to three times its normal diameter. Then after this work was done on the animals it was changed over and this little plug was adapted so that it could be introduced through the cystoscope and applied at the clinic. The plug was made from a small piece of laminaria with an opening through it. Inserted through the cystoscope and left in place, the plug swells. The opening in the plug also swells, so that if it is a No. 6 when it goes in, in an hour or two it swells to a No. 15, varying somewhat. The urine trickles through the hole and the ureter begins to dilate above the plug. The procedure is painless. Our clinical experience with it so far has been limited to one case in which there was a stone about a third of the way down the ureter and two stones in the kidney. We put the plug in place and left it there for a day, and the day following the man passed his stone. Then we sent him out to ride the roads in a well known automobile which the doctors commonly use and he shook the two stones into his ureter. He came back and we put the plug in his ureter again and he passed the two stones.

Dr. B. S. Barringer, New York: I should like to report just one unusual pyelogram result which misled us a great deal. The patient came to the Bellevue Hospital with symptoms of stone. A roentgenogram was made and a nest of three or four stones was found just above the crest of the ilium. We cystoscoped him and found an inflamed bladder and two ureters, and we injected thorium into the suspected kidney pelvis, with the result that we had a beautifully dilated pelvis up under the ribs. The thorium was plainly outlined, and the nest of stones down about 3 inches from this dilated kidney pelvis with no connection between the two.

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We thought he had double ureters and a double renal pelvis and that we had missed one of the ureters on cystoscopy. At the operation we looked for two ureters but did not find them. We found a large, dilated pelvis with a stone at the lower end. The thorium probably had not had time enough to diffuse through the entire pelvis.

Dr. J. E. Burns, Baltimore: About 30 per cent. of the calculi are missed in the plain roentgenogram. I have already called attention to the fact in several publications that the ureteral calculi missed in the plain roentgenograms are brought out by the thorium solution, either by the adhesive qualities of the solution or by its comparative density, or by the fact that the thorium solution is absorbed by the calculi. We have used this solution since its introduction in the Brady Clinic about two years ago in, I suppose, 400 cases. We have seen no ill results in any case. None of the cases have shown any necrosis or any destruction of renal parenchyma due to retention, which latter occurs very rarely, if at all.

It is essential that the solution be allowed to flow in while the roentgenogram is being made, so that the pelvis and ureter may be fully dilated. On repetition of the roentgenogram in such cases it might be well, in order to insure complete distention of the pelvis, to lower the head of the table and allow the solution to flow in by gravity. If the first attempt is not good, and if the ureterogram is not clear in the lower portion, the position, of course, should be reversed, and it will be found in practically every instance that the ureteropyelogram will be satisfactory.

Another important thing in the diagnosis of ureteral calculus is to employ the wax-tipped catheter. This, together with the pyelogram and the plain roentgenogram, is employed as a routine measure in the Brady Clinic.

Dr. A. J. Crowell, Charlotte, N. C.: I do not believe the presence of blood in a centrifugalized specimen of urine obtained by ureteral catheter means as much as some would seem to think. It is difficult, yes, almost impossible, I believe, to get urine with the ureteral catheter without getting some blood in a centrifugalized specimen of urine thus obtained. The presence of pus, of course, is a different thing. Personally I do not lay much stress on the presence of blood, but the presence of pus is very significant.

Just a little off the subject, and yet brought out by Dr. Bugbee in his paper, is the removal of stone from the ureter by the use of the ureteral catheter. About three years ago while endeavoring to remove a recently impacted stone from the ureter it occurred to me that it would be common sense to inject cocain or novocain into the ureter to deaden the sensation and thus allow the ureter to relax and assist the stone to pass out. This procedure was carried out and the next day the stone was found in the patient's bladder. Of

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course, this stone may have passed if nothing had been done, but it encouraged trying the plan in other cases. Since that time I have had twenty-three or twenty-four cases and have had to operate on only two patients for the removal of ureteral stone. I am convinced now that if I had persisted then (that was in the beginning of this work) as I do now I would have removed those two. It may take a number of treatments to remove stones in this way, but I believe that every recently impacted ureteral stone can be removed in this way if we get at it in time. I removed three from one ureter but it required six or eight treatments. If we will only persist in our efforts with the cystoscope and some form of local anesthesia, I believe we will seldom fail to remove these stones.

Dr. C. M. Harpster, Toledo, Ohio: I wish to endorse the position taken by Dr. Smith and Dr. Fowler. I believe if we make careful investigations of the urine we will, with the possible exception of a few cases, find microscopic blood. I think this is our most important diagnostic point clinically. The possible exception is in those cases in which there has been an occlusion of the ureter from impaction of the stone in the ureter or in the pelvis of the kidney; and in those cases in which there has been complete exclusion of the ureter, of course, we would not find microscopic blood; but in my experience I have, in a large number of cases, found microscopic blood after painstaking investigation.

Another point is in regard to reflex anuria which follows cases in which there is a single impacted stone on one side. It has been my experience in those cases in which there is anuria lasting three, five, and, in one case, ten days, that we will, on careful and repeated roentgen-ray examinations, find an impacted stone on the other side. In every case in which there have been bilateral calculi reflex anuria has not been found present. In those cases, I believe, we should make repeated searches to locate the stone on the other side. One of my old preceptors, Professor Israel, laid particular stress on this point, and in two cases I believe we were able to save the patients' lives. Where there is complete anuria differentiated from nephritis, in nephritis we will at least have a teaspoonful of urine excreted; that is, we will not have in any nephritic condition a complete and absolute anuria; and so by remembering this point I was able, in two cases of ureteral calculus in which experts had made a diagnosis of nephritis with complete suppression of urine, to find bilateral ureteral calculi.

Dr. Edward L. Young, Boston: Dr. Bugbee's trick of coiling a ureter catheter around a stone is a very pretty trick and is a great help, provided it comes out all right. One case in connection with it might perhaps serve as a little warning in the use of the procedure—a case in which a ureteral stone

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was hooked in that fashion, but then the fisherman was not able to bring in the fish, and for over an hour tried to get the catheter out. So I think there is a warning in regard to the use of the ureter in that condition, on account of the possibility of breaking off the catheter and also of getting the catheter up and having it caught there.

I wanted to emphasize what has been already emphasized, the indefiniteness of the symptoms in the majority of cases of renal stone, and also that typical symptoms do appear, including blood and pus, without any calculus being present, and especially the symptom of pain. I think all statistics of pain in connection with calculus show that it is almost always indefinite and often misleading.

I have not looked up the cases at the Massachusetts General Hospital in regard to crossed symptoms, but I can only remember having seen two cases within a comparatively recent time, and I should like to register my opinion that a damaged kidney on one side without any symptoms, and a normal kidney on the other which seems to have the symptoms, is a comparatively rare condition. I do not mean that symptoms may not be mainly on the undamaged or slightly damaged side, but I think a normal kidney on one side showing symptoms and a damaged kidney on the other not showing any symptoms is, at least in my experience, rare.

Then the question of the removal of ureteral stones without operative procedure which has been spoken of so enthusiastically by every one today—I do not know whether we in Boston are slower than the rest of you in making a diagnosis, or less skilful in the use of the operating cystoscope, but we see large ureteral stones that I am convinced it would be impossible to remove by any method short of the open operation. Likewise, we fail to get stones of moderate size out in a percentage of cases larger than that spoken of today.

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THE VALUE OF MAKING LEUKOCYTE COUNTS ON THE URINE IN INFECTIONS OF THE KIDNEY

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During the past three years we have been controlling all cases of renal infection, including tuberculosis, that have been admitted to the Presbyterian Hospital, by making leukocyte counts on the urine. It has seemed to us that this was the only way one could obtain definite and exact information relative to the severity of the infectious process, and furthermore, it has been giving us an idea of the improvement in the patient's condition while under treatment.

The idea of making leukocyte counts on the urine is not a new one. Its routine use, however, in the control of urinary infections, hand in hand with bacteriologic controls, I do not think has become an established procedure. I am not familiar with any clinic or laboratory that employs the leukocyte count on the urine as a routine in its daily work, so that I believe the statement is justified, that, as a rule, this procedure is very rarely, if ever, employed in routine clinical work. Just why this should be is not clear, for it is hard to see how one can do accurate work and get along without its use as a control of the progress made in cases of urinary infection that are under treatment.

This method is particularly valuable for informing us of the progress made in cases of infection of the renal pelvis which are being treated by pelvic lavage.

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TABLE 1.—RESULT OF TREATMENT IN CASE 1

Date	Leukocyte Count			Cultures			Treatment	Remarks
	Right	Left	Bladder	Right	Left	Bladder		
11-15-15	360,000	240	220	Sterile	Sterile	Sterile	5 c.c. 10 per cent. protargol; pelvic lavage	
11-29-15	88	308	5,280	Sterile	Sterile	Sterile	5 c.c. 10 per cent. protargol; pelvic lavage	
12- 5-15	4,000	3,850	44	Sterile	Sterile	Sterile	5 c.c. 10 per cent. protargol; pelvic lavage	
12-14-15	24	13	..	Sterile	Sterile	Sterile	7 c.c. 1 per cent. silver nitrate; pelvic lavage	
12-18-15	.....	..	16	.....	.....	Sterile	.....	No cystoscopy
12-26-15	.....	..	16	.....	.....	Sterile	.....	No cystoscopy
1-11-16	.....	..	35	.....	.....	Sterile	.....	No cystoscopy
1-23-16	.....	..	63	.....	.....	Sterile	.....	No cystoscopy

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TABLE 2.—RESULT OF TREATMENT IN CASE 2

Date	Leukocyte Count			Cultures			Treatment
	Right	Left	Bladder	Right	Left	Bladder	
5-21-15	638	254	690	B. coli	B. coli	B. coli	Pelvic lavage, 1 per cent. silver nitrate
6-16-15	260	126	300	B. coli	B. coli	B. coli	Pelvic lavage, 1 per cent. silver nitrate
9- 3-16	90	80	100	B. coli	B. coli	B. coli	Pelvic lavage, 1 per cent. silver nitrate
9- 4-16	49	40	77	B. coli	B. coli	B. coli	Pelvic lavage, 1 per cent. silver nitrate
9- 9-16	40	35	115	B. coli	.....	B. coli	Pelvic lavage, 1 per cent. silver nitrate
10-12-16	..	..	..	B. coli	B. coli	B. coli	Pelvic lavage, 1 per cent. silver nitrate
10-27-16	32	20	44	B. coli	Sterile	B. coli	Pelvic lavage, 2 per cent. silver nitrate
11- 6-16	3	8	20	Sterile	Sterile	B. coli	Pelvic lavage, 2 per cent. silver nitrate
11-14-16	..	..	154	.....	.....	B. coli	
11-20-16	..	..	11	.....	.....	Sterile	
11-22-16	..	..	8	.....	.....	Sterile	
11-24-16	..	..	20	.....	.....	Sterile	

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As a rule, indefinite terms, such as "more or less," and sometimes plus signs are used, when referring to the amount of pus present in the urine. In a general way, these terms, being relative, may suffice. Nevertheless, they are open to the criticism that they are not accurate and one cannot tell from time to time the exact amount of progress the patient has made. There can be no question that when one wishes to carry out more accurate work, the use of plus signs, as well as the indefinite terms at present in general use, is most unsatisfactory.

In the treatment of cases of pyelitis by pelvic lavage, one can tell absolutely whether or not the patient is making progress by a comparison of the leukocyte counts made each time the ureters are catheterized. In several instances we have noticed a transitory rise in the leukocyte count after the patients were treated with silver nitrate. We take it that this transitory increase in the number of cells was due to the medication. In many instances, the amount of fall in the leukocyte count from time to time following each treatment has been very striking, as will be illustrated in the case reports.

This method may be criticized as being inaccurate and containing the possibilities of error. Doubtless there are many factors which have a direct bearing on the volume of the urine. Nevertheless, it is surely much more accurate than no method at all, and far superior to the use of more or less indefinite terms. This method, technically, is just as accurate as is the counting of the leukocytes in the blood. In view of the fact that the blood volume is constant, the normal number of leukocytes in the blood per cubic centimeter is practically constant. The urinary leukocyte count will naturally vary with the urinary output and is subject to certain variations. The count will be high or low in direct relation to the urinary output.

In order to make our counts as nearly as possible under the same conditions, our patients are instructed

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to drink 6 ounces of water two hours before and 6 ounces more one hour before the urine is to be examined. Just before taking the first glass of water, that is, two hours before cystoscopy, the patient voids, so that the bladder at this time is empty.

In the cases to be reported in this series, the counts were made on specimens obtained from the right and left kidneys through the ureteral catheter and from catheterized bladder specimens. In a few instances, only the bladder urine was counted, after the kidneys were free from infection and pus.

If each count is made under the same conditions and compared with each previous count, I believe that this method has a distinct value in showing the improvement made from one examination to the next. This can be seen by referring to the case reports.

TECHNIC OF MAKING THE COUNT

In making the leukocyte counts, the urine is not centrifuged. The specimen is vigorously shaken so as to have the leukocytes and the urine well mixed. Toison's solution is drawn to the 0.5 mark and then urine is drawn to 11. This is agitated and a drop of fluid placed on a blood-counting chamber, covered with a cover glass, and the leukocytes are counted in the usual way.

As an example of the results obtained by this method, I wish to present the histories of a few cases which have been selected at random from our records of cases of pyelitis which have been treated by pelvic lavage and in which the degree of infection was controlled by making routine leukocyte counts.

REPORT OF CASES

CASE 1.—J. S. F., man, aged 40, on whom a diagnosis of pyelitis with arthritis was made, had begun to have trouble six years previously with a painful swelling of the right knee. This was followed a few weeks later by a similar condition in the other knee. Since then the patient has suffered from arthritis, growing worse gradually. About three years ago the patient began gradually to have urinary disturbances.

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TABLE 3.—RESULT OF TREATMENT IN CASE 3

Date	Leukocyte Count			Cultures			Treatment
	Right	Left	Bladder	Right	Left	Bladder	
10-16-16	165	55	880	B. coli, staph.	B. coli, staph.	B. coli, staph.	Pelvic lavage, 1 per cent. silver nitrate
12- 7-16	99	33	220	B. coli	B. coli, staph.	B. coli, staph.	Pelvic lavage, 1 per cent. silver nitrate
12-22-16	*	*	*	.....	.....	.....	Pelvic lavage, 1 per cent. silver nitrate
12-30-16	8	0	0	Sterile	Sterile	Sterile	Pelvic lavage, 1 per cent. silver nitrate

* Cultures lost.

TABLE 4.—RESULT OF TREATMENT IN CASE 4

Date	Leukocyte Count			Cultures			Treatment
	Right	Left	Bladder	Right	Left	Bladder	
6-22-16	1,122	1,244	1,476	B. coli	Negative	B. coli	Pelvic lavage, 1 per cent. silver nitrate
9-28-16	1,704	242	143	B. coli	Negative	B. coli	Pelvic lavage, 1 per cent. silver nitrate
11-16-16	132	22	187	Sterile	Sterile	Sterile	Pelvic lavage, 2 per cent. silver nitrate
11-28-16	123	18	187	Sterile	Sterile	Sterile	Pelvic lavage, 2 per cent. silver nitrate

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TABLE 5.—RESULT OF TREATMENT IN CASE 5

First Admission

Date	Leukocyte Count			Cultures			Treatment	Remarks
	Right	Left	Bladder	Right	Left	Bladder		
1- 5-15	.....	.....	1,240	.....	.....	B. coli	.....	During the patient's first stay in the hospital she was examined by cystoscope only once; no urine was obtained from the left catheter
1- 7-15	3,520	.....	1,370	B. coli	.....	B. coli		
1-17-15	.....	.....	161	.....	.....	B. coli		
1-18-15	.....	.....	64	.....	.....	B. coli		
1-19-15	.....	.....	350	.....	.....	B. coli		
1-20-15	.....	.....	27	.....	.....	B. coli		
1-20-15	.....	.....	91	.....	.....	B. coli		
1-21-15	.....	.....	33	.....	.....	B. coli		

Second Admission

5-10-15	.....	.....	88	.....	.....	B. coli		
5-12-15	.....	.....	770	.....	.....	B. coli		
5-13-15	.....	.....	153	.....	.....	B. coli		
5-17-15	48	33	100	B. coli	B. coli	B. coli	Pelvic lavage; 2 per cent. silver nitrate	
5-24-15	15	22	13	B. coli	Negative	B. coli	Pelvic lavage; 2 per cent. silver nitrate	
6- 1-15	30	28	40	Sterile	B. coli	B. coli	Pelvic lavage; 2 per cent. silver nitrate	
6- 7-15	26	54	42	Sterile	Sterile	Sterile	Pelvic lavage; 2 per cent. silver nitrate	
6-19-15	11	27	22	Sterile	Sterile	Sterile	Pelvic lavage; 2 per cent. silver nitrate	

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He was obliged to void about four times every night and sometimes more. There was a burning pain in the urethra.

On admission the patient urinated every half hour during the day. He has had pyuria for several years. The cystoscopic examination showed a generalized cystitis. There were many flakes of mucopus adherent to the bladder wall. Ureteral catheterization was easy and without obstruction. Examination of the urine revealed the presence of pus in the bladder and in the right and left kidney urines. All cultures have remained persistently sterile.

The result of the treatment and its effect on the leukocyte count may be seen at a glance by referring to Table 1.

CASE 2.—Mrs. E. H., aged 28, on whom a diagnosis of colon pyelitis was made, had had bladder trouble for many years. She had been married nine years. On her honeymoon she had an attack of cystitis, with severe burning pain on urination. At this time she also had frequency, so that she was obliged to rise several times during the night. She had occasional attacks of chills and fever which had been attributed to malaria and to her appendix. She complained of pain on the right side both in front and in back. Four and a half years ago, during an acute attack of pain on the right side, her appendix was removed. She was told that it was not diseased. Cystoscopic examination proved the bladder to be negative. Catheterization of the ureters was easy and without obstruction. The urine showed the presence of pus in both right and left kidneys and in the bladder. Cultures showed *Bacillus coli*. The roentgen-ray examination was negative for calculi. The treatment was pelvic lavage.

CASE 3.—Mrs. Dr. F., aged 28, on whom a diagnosis of pyelitis during pregnancy was made, dates the onset of her present trouble from the sixth month of her pregnancy. It was accompanied by severe pain in the right side and in the back. The pain gradually grew worse and was followed by a rise in temperature. The patient had several attacks of chills and fever. Her temperature varied from 95.2 to 103 F. between 1 a. m. and 8 p. m. The patient had her appendix removed for a similar attack of pain before she was married. Cystoscopy revealed a mild cystitis. Ureteral catheterization was easy and without obstruction. The urine from the right and left kidneys and from the bladder showed the presence of pus and a mixed infection of *B. coli* and staphylococci. The patient was given four treatments of pelvic lavage with silver nitrate.

CASE 4.—Dr. L. R. F., a man, aged 38, whose case was diagnosed as pyelitis, was operated on in January, 1917, for hemorrhoids. Following catheterization, cystitis developed,

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TABLE 6.—RESULT OF TREATMENT IN CASE 6

Date	Leukocyte Count			Cultures			Treatment	Remarks
	Right	Left	Bladder	Right	Left	Bladder		
12- 8-16	451	80	1,100	B. coli	Sterile	B. coli	Pelvic lavage; 1 per cent. silver nitrate	
12-12-16	...	..	.....	Sterile	Sterile	Sterile	Pelvic lavage; 1 per cent. silver nitrate	No cell counts made
1- 4-17	0	0	0	Sterile	Sterile	Sterile	Pelvic lavage; 1 per cent silver nitrate	

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accompanied by frequent urination and pain. The urine was examined and pus and *B. coli* were found. The roentgen-ray examination was negative. Cystoscopy showed the following: The bladder was negative. Double ureteral catheterization was easy and without obstruction. The urine from the right and left kidneys and from the bladder showed the presence of pus. The right kidney and bladder urines showed *B. coli*. The left kidney was sterile. The patient was treated by pelvic lavage with silver nitrate.

CASE 5.—Mrs. F. P., aged 27, whose case was diagnosed as colon pyelitis, complained of frequent and burning pain on urination, chills and fever, and pain in the right lumbar region. Severe backache at night began about three weeks ago, which was relieved by lying on something hard. The urine became irritating and she was obliged to urinate every few minutes, both day and night. At this time she began to have chills which were followed by a rise of temperature. For a few days previous to this she had had two severe chills each day. A steady backache had been present for the last three weeks. The roentgen-ray examination was negative for stone. Cystoscopy showed the right ureter edematous and swollen. The left appeared normal. A mild degree of cystitis was seen at the base. Ureteral catheterization revealed no urine from the left kidney. That from the right side contained pus and *B. coli*. At the subsequent examinations there was no difficulty in obtaining the urine from the left kidney. The patient was given the usual pelvic lavage treatments.

CASE 6.—Mrs. E. L. H., aged 41, on whom a diagnosis of pyelitis following pregnancy was made, was suddenly seized, one month after her last pregnancy, with an attack of high fever, associated with chills and sweating. Her temperature varied from 100 to 102.5 F. There were no bladder symptoms. This attack of chills, fever and sweating lasted for sixteen weeks. During this time the urine showed the presence of pus and *B. coli*. The second attack occurred last fall, when the patient was suddenly seized with severe chills and fever, associated with severe pains in the back and lumbar region. The roentgen-ray examination was negative for stones. Cystoscopic examination showed the bladder negative. Bilateral ureteral catheterization was easy and without obstruction. Pus and *B. coli* were found in the bladder urine and in the urine from the right kidney. The left kidney urine was sterile. The patient was treated by pelvic lavage.

CONCLUSIONS

1. This method is of distinct value in showing the improvement made from time to time while the patient is under treatment.

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2. It can be carried out without any trouble or inconvenience to the patient.

3. No conclusions can be drawn from a single count. The value of the method must depend on making each count under exactly the same conditions.

4. This method should be considered from a standpoint of comparison.

122 South Michigan Avenue.

ABSTRACT OF DISCUSSION

Dr. Martin Krotoszyner, San Francisco: While I have no experience with comparative quantitative determination of leukocytes present in renal urines, I have for a number of years employed their comparative qualitative estimation for diagnostic purposes in bilateral renal lesions. From the difference in the shape, outline and size of leukocytes and their nuclei, valuable conclusions are feasible in many instances on the nature and extension of the bilateral process, and it is fair to assume that by these means Dr. Kretschmer's method might gain materially in diagnostic significance.

Dr. W. C. Quinby, Boston: Dr. Kretschmer has added one more method to our armamentarium. It is undoubtedly one of value, and can be performed by the clinician. Although I have not investigated the leukocyte count in the urine, I have followed such cases by the bacterial count. The urine of patients under treatment by pelvic lavage has been examined at intervals of about a week in the bacteriologic laboratory. The culture is plated and the number of colonies which grow in a given length of time counted. This can be done with a good deal of accuracy, and, to my mind, is probably better in estimating the progress of a case under lavage than counting the leukocytes. I concede, however, that counting the leukocytes is of real value if a competent bacteriologist is not available.

Dr. George A. Wyeth, New York: I should like to ask Dr. Kretschmer what he considers the normal.

Dr. H. L. Kretschmer, Chicago: About ten to fifteen.

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SURGICAL DISEASES OF THE URINARY TRACT IN CHILDREN

WITH SPECIAL REFERENCE TO THE VALUE OF CYSTOSCOPY

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It is not generally recognized that children are subject to most of the urologic diseases common to the adult. A review of recent pediatric and surgical literature would lead one to believe that, excluding a few well recognized conditions (as vesical calculus, pyelitis, and renal tumors), urinary diseases were very rarely encountered. However, as a result of clinical experiences and postmortem examinations, we are convinced that diagnosis, in affections of the urinary tract, is by no means accurate, and that, in consequence, many cases are overlooked.

The reasons for this state of affairs are as follows: 1. Diagnosis in general is much more difficult in infancy and childhood. 2. We are deprived of the information obtained by a careful history. Too often we must be guided by fragmentary descriptions of symptoms given by parents or nurses. Unless the condition, therefore, is clear cut with characteristic symptoms (as in vesical stone), it may be impossible to differentiate, by ordinary means, bladder or renal diseases from other affections. 3. Palpation, unless performed under anesthesia, is rather unsatisfactory in children. Then again, palpation is, at times, unreliable as a diagnostic aid, for absence of enlargement of the kidney by no means excludes disease (as in early tuberculosis, and small renal tumors). 4. The

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modern methods of examination which are considered routine in the adult are seldom applied in the young. The latter probably furnishes the chief reason for the numerous mistakes and uncertainties in diagnosis in this field. Cystoscopy, ureteral catheterization, functional tests, and the Roentgen ray have not supplanted the older, time-worn procedures. The subject of urology, in its newer conception, is given scant attention and rarely is reference made to the value of cystoscopy. A number of textbooks ignore these methods, a few describe them perfunctorily, with comments as to impracticality and difficulty. Instead of cystoscopy, it has been suggested that both kidneys be exposed and examined through lumbar incisions before attempting radical operative procedures. This, despite the fact that exploratory exposure of the kidney has often been shown to be of no value. At operation it has frequently been demonstrated that there may be no pathologic changes evident by inspection and palpation, and still serious disease be present (tuberculosis localized in the pelvis or papilla, renal calculus, etc.).

The object of this article is two-fold: first, to call attention to the feasibility of applying in the young, in the great majority of cases, the same diagnostic procedures used in the adult, namely, cystoscopy, ureteral catheterization, Roentgen ray, cystography, and the functional tests; and second, that surgical diseases of the urinary tract in infants and young children are not so uncommon as we are led to believe.

CYSTOSCOPY AND URETERAL CATHETERIZATION IN EARLY CHILDHOOD

Nitze[1] was the first to call attention to the use of cystoscopy and ureteral catheterization in children, having, in a few instances, successfully cystoscoped males as young as 8 years of age. In younger children where this examination was urgently indicated

1. Nitze: Lehrbuch der Kystoskopie, 1907, p. 97.

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and the caliber of the urethra prevented instrumentation, a perineal urethrotomy was advised, through which the instrument could be passed. Casper[2] and Jacoby[3] each described a child's cystoscope but made no mention of its use clinically. Since then, few articles dealing with this subject have been published. This is probably due to the fact that up to a short time ago, satisfactory cystoscopes of small caliber were not available. At the present day, when such instruments can be obtained, but few clinics are supplied with the armamentarium necessary for these examinations. In females over 6 years of age, the ordinary adult cystoscope (21 French caliber) may safely be used, for the urethra possesses marked dilatability. In 1908, Portner[4] described a new child's observation and catheterizing cystoscope and reported its successful use in a number of cases. The observation cystoscope has a caliber of No. 12 French, the catheterizing instrument No. 17 French. With these he succeeded in cystoscoping boys of two, and catheterizing them at 8 years of age. Portner's cystoscopes were found to be unsatisfactory on account of the flexibility of their long shafts. Beer,[5] in 1907, had two instruments made by the Kny-Scheerer firm (Reiniger, Gebbert and Schall), and published the results of his experiences with them a few years later. The catheterizing cystoscopes are Nos. 15 and 18 French, the observation instruments approximately 10.5 and 12.5 F. caliber. The shafts are made to fit the length of the urethra of a 5-year old boy (8-10 cm.), and are 9.5 cm. and 12 cm. in length, respectively. Each is so constructed that the catheterizing sheath can be readily detached, making an examining and single catheterizing cystoscope in one. Both have an Albarran finger for guiding the catheter and take

2. Caspar: Handbuch der Cystoscopie, Leipzig, 1911.
3. Jacoby: Lehrbuch der Kystoskopie, Leipzig, 1911.
4. Portner: Deutsch. med. Wchnschr., 1908, No. 43.
5. Beer: Cystoscopy and Ureteral Catheterization in Young Children, Jour. of Surg., March, 1911.

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a No. 4 to 5 F . The optical system which is modeled after Nitze, gives a very clear, though small, picture. With these instruments, Beer examined cystoscopically male children of 5 years, and females as young as 14 months of age. The youngest child whose ureters were catheterized was a girl 5 years old. These cystoscopes have been in use since 1907 and have been found very serviceable, their great advantage being smallness of caliber and shortness of shaft.

We have records of more than thirty children under 9 years of age who have been cystoscoped during the past few years. The youngest patient was a boy of 17 months who was subsequently operated on for a kidney tumor. The youngest male catheterized was under 3 years old — the youngest female 22 months of age.

INDICATIONS AND CONTRAINDICATIONS FOR CYSTOSCOPY IN THE YOUNG

While cystoscopy in young children is devoid of danger, the indications for its application are not as broad as in the adult. The fact that a general anesthetic is required in most cases acts somewhat to restrict its use as a routine diagnostic procedure. It should be reserved for those cases in which surgical affections of the urinary tract are present; or as an aid in differentiating conditions which may be confused with diseases of the urinary organs. Care should be taken to rule out cases with urinary symptoms due to functional disturbances so frequently met with in young children (for example enuresis — hyperacidity of urine). Urinary findings unfortunately cannot be relied on to serve as a reliable guide on which to base indications. At times advanced lesions of the kidney may be present, and the examination of the urine give no intimation of the condition. A pyonephrosis with obstruction of the ureter on the diseased side may show an absolutely normal urine. Cases of congenital stricture of the ureter pro-

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ducing pyonephroses, with negative urinary findings, have been reported from time to time in the literature.[6] In tumors of the kidney also the urine frequently fails to contain any abnormal constituents. Pyelitis can generally be diagnosticated without cystoscopy, and should therefore contraindicate this examination. Every case of pyuria which does not respond to the usual methods of treatment, especially when accompanied by fever, loss of weight and strength, should be cystoscopically examined. Hematuria is also a distinct indication, unless it be proved that the bleeding is but an expression of a hemorrhagic diathesis (purpura hemorrhagica, hemophilia, leukemia, scurvy); or a hemorrhagic nephritis. Renal diseases are often simulated by intraperitoneal conditions; in these cases, cystoscopy is of great value in the differential diagnosis, and its application will often render unnecessary exploratory operations. Before deciding to remove a kidney no matter how badly diseased, the presence of the second should always be ascertained. Cystoscopy is not absolutely essential if the Roentgen ray shows the shadow of the other organ. It is of great service when no focal renal symptoms are present, and the kideys cannot be palpated, in determining the side of the lesion.

Contraindications have been mentioned in discussing pyuria and hematuria. In addition, when the child's condition is such as to preclude a general anesthesia, should this be necessary. Every case, however, must be considered by itself, and if there exists the slightest suspicion that cystoscopy will aid in the diagnosis, it should be used.

Functional tests: When ureteral catheterization is not feasible, chromo-ureteroscopy will be found invaluable. It is possible by using this method to make a positive diagnosis in the majority of instances with the ordinary observation cystoscope. Indigo-

6. Kahn: Congenital Stricture of Ureter Producing Pyenephrosis, Med. Rec., New York, Nov. 16, 1912.

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carmine (10 c.c. of 0.4 per cent. solution) is injected about fifteen minutes before the examination, and both meati carefully watched. First the time of appearance of the dye on each side is observed; then the intensity of the color, whether light or dark blue; and lastly, note made of the contractile force with which the colored urine is ejected from the orifice. The latter points are of great importance; a very light blue stream which simply dribbles away is indicative of disease. Normally the dye appears in ten to fifteen minutes; its absence indicates grave renal impairment. When combined with catheterization, we have the additional data obtained by the examination of the separated urines.

The status of the other functional tests now in vogue has been summed up as follows by Leopold and Bernhard:[7] "Figures for the nonprotein constituents of the blood as well as for the phenolsulphonephthalein excretion of children free from renal disease are practically identical with the figures obtained from adults, and vary within the normal figures as adult figures vary. The changes in these figures in children the subjects of renal disease correspond with the changes observed in adults. The importance of the tests for diagnosis and prognosis amply demonstrated in adults will in all probability, hold true for children." We have not used the phenolsulphonephthalein test in conjunction with cystoscopy and ureteral catheterization, but have confined its use to estimating the total functionating capacity of both kidneys.

TECHNIC OF CYSTOSCOPY AND URETERAL CATHETERIZATION IN CHILDREN

This does not vary much from the routine followed in the adult. Most cases must be examined under narcosis, and a deep anesthesia is generally required

7. Leopold and Bernhard: The Nonprotein Nitrogenous Constituents of the Blood, and the Phenolsulphonephthalein Test in Children, Amer. Jour. Dis. Child., June, 1916.

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before the bladder reflexes are abolished. Occasionally it is possible in very young children, especially girls (3 to 4 years), to use the cystoscope under local anesthesia (novocain). The indigocarmin is injected ten to fifteen minutes before the anesthesia is started. It is often advisable to insert a small catheter into the bladder and wait until the color first appears in the urine before administering the anesthetic. The bladder is then irrigated with a small syringe, and filled with a sterile solution. The capacity of the bladder in a 1-year old child is approxiametly 100 c.c., so that 120 c.c. is a safe amount for those over 3 years. As most of the catheterizing instruments for children are single tunneled, but one ureter can be catheterized at a time. It is seldom necessary to catheterize the two. A specimen from the diseased side is generally taken, and the excretion of indigocarmin from the other side noted; this suffices. Occasionally difficulty will be experienced (especially when using a No. 4 catheter) in obtaining a specimen; under such conditions, it is advisable to employ aspiration with a small syringe, or to inject a few cubic centimeters of sterile solution through the catheter, to start the flow.

Radiography.—In children, radiography is of greater diagnostic value than in the adult and should be used more frequently, especially in cases in which the cystoscope cannot be used. Its importance lies in the fact that with good technic the outline of the kidneys can be distinctly shown and deviation in position, size and shape noted. It is at times possible to distinguish an intra-abdominal tumor from renal enlargement.

Cystography.—Roentgenographic studies of the bladder with silver salts, or thorium, is a harmless and often valuable procedure. In chronic vesical retention of urine in children, cystography aids materially in corroborating the diagnosis and in determining the degree of involvement of the ureters and

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the kidneys. The bladder is filled with one of the solutions mentioned, the child placed in the Trendelenberg position, and radiographed. The radiogram shows distinctly in the more advanced cases the considerably enlarged bladder with dilated ureters and renal pelvis. Diverticulae of the bladder are well shown in the cystogram, and a more accurate idea obtained of their size and shape than by cystoscopic examination. The diagnosis of this condition is practically impossible without recourse to one of the two methods mentioned.

In the examination of children suspected of urinary disease, it is advisable, as in the adult, to follow a certain routine. The different steps of the examination should be carried out in their proper sequence, thus avoiding unnecessary repetition. The following has been found the most satisfactory: 1, History; 2, physical examination; 3, urinalysis; 4, roentgenography; if cystoscopy is contraindicated, or cannot be performed — cystography; 5, instrumental examination, which may include bladder catheterization — the stone searcher, and cystoscopy combined with injection of indigocarmine. If cultures of the urine are desired, catheterization is advisable. It is seldom necessary to collect a twenty-four hour specimen, a single one generally suffices. Roentgenography should include the entire urinary tract, not alone the side towards which suspicion is directed.

The material embodied in this paper is based on a group of thirty-eight cases from the children's surgical wards of Mount Sinai Hospital, and from private records.† The youngest patient operated on was a girl, 11 months of age. This point emphasizes the fact which has been noted in a number of instances, that young children bear major operative procedures on the urinary tract very well. One should not hesitate on account of the extreme youth of the patient

† I wish to thank Dr. Beer for the use of his private records, which have been incorporated in this article.

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to operate, provided the child is in fair condition. As an instance, I may refer to a case recently reported by Kakels,[8] in which an infant 6 weeks old had a nephrectomy performed for a large congenital hydronephrosis. Operation was followed by an uninterrupted recovery.

The youngest patient in this group was 11 months old, the oldest, 13 years; the majority of the cases were in children between 4 and 8 years of age.

The series to be described by case reports illustrating the various points previously mentioned, comprises the following surgical diseases of the urinary tract.

	Cases
Perinephritic abscess	4
Renal tuberculosis	3
Renal calculus	2
Ureteral calculus	1
Vesical calculus	1
Tumor of Kidney (Wilms)	2
Sarcoma of Kidney	2
Pyelonephritis (unilateral)	1
Pyelonephritis (bilateral)	2
Hydronephrosis (congenital)	1
Hydronephrosis (traumatic)	1
Suppurative nephritis	1
Subacute nephritis	1
Diverticulum of bladder	1
Chronic vesical retention of urine	12
Nephroptosis	1
Perinephritis (nonsuppurative)	1
Contusion of kidney	1

Perinephritic Abscess.—There were four cases in this series, the youngest an infant of 16 months. Two patients were cystoscopically examined, one a child 20 months of age. The urine was negative in all but one case in which pus and blood were present. The abscess in this instance was caused by the perforation of a cortical abscess of the kidney into the perinephritic tissue; at operation this could be definitely determined. Cultures from the pus in three cases showed *Staphylococcus aureus,* in the fourth *Streptococcus hemolyticus.* The diagnosis is not difficult,

8. Kakels: Large Congenital Hydronephrosis in an Infant Six Weeks of Age, New York Med. Jour., March 18, 1916.

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and is readily confirmed by aspiration. Cystscopy is seldom required for corroboration. Incision and drainage effect a cure unless there is marked renal involvement. Two of the patients had crops of furuncles preceding the development of the perinephritic abscess.

REPORT OF CASES

CASE 1.—*Left perinephritic abscess.*—P. K., aged 3 years, was admitted to Mount Sinai Hospital July 20, 1914. The patient had measles at 9 months; had furnuncles on buttocks a few weeks ago; these disappeared without surgical treatment. The present illness began a few days ago with fever, pain in the left loin, and vomiting. The mother noticed a bulging mass in the left side. Physical examination demonstrated a large, tender, fluctuating mass in the left costovetebral angle. On aspiration a thick pus obtained. Culture, *Streptococcus hemolyticus.*

Operation consisted of incision and drainage of the perinephritic abscess. The kidney was not explored; tube drainage was instituted. Recovery was uneventful. The patient was discharged from the hospital a few weeks later.

Renal Tuberculosis.—Tuberculosis of the kidney in children is considered a rare disease. Oraison,[9] in 1913, called attention to the fact that but fifty-one cases had been published in the literature. Wildbolz[10] collected 896 cases in which tuberculosis of the kidney, in a surgical form was clinically recognized forty-eight times. Necropsy findings, however, tend to prove that the condition is much more common than clinical statistics indicate. O. Muller[11] found renal tuberculosis thirty-three times in a series of 100 necropsies on tuberculous children, Dickinson,[12] forty-nine times in 300 cases; Rilliet and Barthez[13] found 15 per cent. of 312 tuberculous children had renal involvement. The Berne pathologic institute reports thirteen cases, in a series of 126 — almost 10 per cent.

9. Oraison: Jour. d. Urologie.
10. Wildbolz: Chirurgie du Nierentuberculose, Neue Deutsche Chirurgie, 1913, 6.
11. O. Muller, quoted by Wildbolz: Chirurgie du Nierentuberculose, p. 4,
12. Dickinson, quoted by Wildbolz: Chirurgie Nierentuberculose, p. 4.
13. Rilliet and Barthez, quoted by Wildbolz: Chirurgie Nierentuberculose, p. 4.

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These figures thus indicate that renal tuberculosis in children is not such a rare condition, and that the application of the modern methods of examination would bring more cases to light. In every suspicious case, the urine should be most carefully examined for tubercle bacilli, and if found negative, inoculated into guinea-pigs. In children up to 10 years, the miliary type of tuberculosis predominates; after this age more cases of the chronic cavernous caseating form are observed.

CASE 2.—*Right renal tuberculosis.*—T. K., a female, aged 10 years, was admitted to the hospital Feb. 1, 1915. The family history and personal history are negative. The patient has had nocturnal enuresis since childhood. For the past few years she has complained of infrequent attacks of pain in the right loin, and for the past 10 months has had incontinence by day, wet clothes every few minutes, loss of weight.

Physical examination shows a poorly nourished child. Heart, lungs and abdomen negative. Kidneys were not palpable. The urine was cloudy. Albumen ++; considerable pus. Cultures were negative. Tubercle bacilli were found in smears. Roentgen-ray examination was negative.

Cystoscopy and ureteral catheterization was performed by Dr. Beer. The bladder capacity was considerably diminished. Around the right ureteral orifice, which seemed retracted, was an exudate. The left orifice was normal. The left ureter was catheterized, showing deep indigocarmin concentration in twenty minutes. The catheter was left in situ, and the bladder catheter was introduced to obtain a specimen from the right kidney. The urine through this catheter became dark blue in one hour.

Palpatation of kidneys under anesthesia was negative. The urine from left kidney contained few white blood corpuscles and red blood corpuscles; few hyaline and granular casts; urea 2.4 per cent. No tubercle bacilli. Bladder urine representing the right kidney revealed white blood corpuscles +++; few red blood corpuscles; urea, 1.8 per cent. Tubercle bacilli were found.

March 3, 1915, nephrectomy for right renal tuberculosis was performed by Dr. Beer. Typical nephrectomy; areas of caseating tuberculosis were found in the upper and lower poles. Incontinence by day ceased within a week after operation. Nocturnal enuresis stopped before the patient left the hospital. Convalescence uneventful.

COMMENT.—This patient was admitted to the hospital for incontinence, which had persisted for ten months despite all forms of treatment. Tuberculosis had not been suspected.

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The incontinence was no doubt due to the constant irritation of a contracted tuberculous bladder by infected urine, for as soon as the cause had been removed, relief was obtained.

CASE 3.—*Left renal tuberculosis.*—I. G., 10 years old, was admitted to the hospital in January, 1916. Family history—negative. Personal history—Had measles and scarlet fever.

Present illness: Eight months ago the patient suddenly experienced difficulty in urinating. This was followed by great frequency and urgency; there was no hematuria. The symptoms persisted for three months, then improved somewhat; for the past three months, he has complained of pain on urination in the end of the penis; has passed bloody urine a few times. No lumbar pain.

Physical examination shows an anemic child, otherwise negative. The kidneys were not palpable (under anesthesia). Rectal examination was negative. The urine was cloudy, acid, with many pus cells; albumen +.

Cystoscopy was performed under ether by Dr. Buerger. The retrotrigonal area was inflamed and in places ulcerated. The left ureter was golf hole shape; the right ureter was normal, covered with fibropurulent exudate.

Indigocarmin appears from the right ureter in fifteen minutes, in good concentration. The left ureter was catheterized and purulent urine obtained; there was no indigocarmin secretion. Tubercle bacille were found in the urine from the left kidney.

Roentgen-ray examination showed the left kidney slightly enlarged, ptosed.

January 22, Dr. Buerger performed nephrectomy for left renal tuberculosis. An enlarged adherent tubercular kidney was removed: caseating areas were found in the lower pone. Uneventful convalescence.

CASE 4.—*Left renal tuberculosis.*—H. H., aged 11 years, was admitted to the hospital Feb. 14, 1916. The family history was negative. Patient was operated on for abscess on the lower end of the spine eight months ago. Four weeks ago the child noticed blood at the end of urination. He also complained of pain in the end of the penis. Since then has frequency and urgency and burning.

Physical examination revealed a fairly well nourished child; the kidneys were not palpable; marked kyphosis of the lumbar spine. The urine was acid; slightly cloudy; albumen +; many pus cells and red blood corpuscles; smears were negative for tubercle bacilli.

Cystoscopic examination was made under ether by Dr. Buerger. The bladder is inflamed in the retrotrigonal region; the left ureteral orifice does not contract or emit urine. There is good indigocarmin concentration from the right kidney, which is readily catheterized. No flow from kidney in thirty minutes. Tubercle bacilli were found in twenty-four hour

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specimen. Roentgen-ray examination, negative; there is no enlargement of kidneys.

Diagnosis: Left renal tuberculosis.

Operation for nephrectomy for left renal tuberculosis was performed by Dr. Buerger. The pathological report showed tubercle bacilli present in the kidneys. There was an uneventful convalescence.

COMMENT.—The symptomatology of these two cases differed considerably from the one first described—they were of the type usually seen in adults. In the first the symptoms dated back eight months, and tuberculosis was not suspected. In both instances there were no focal symptoms—Roentgen-ray was negative, so that without cystoscopy, it would have been impossible to determine which kidney was diseased. The cystoscopic picture is as characteristic as in the adult, and the diagnosis can generally be made with the ordinary observation type of instrument.

Urinary Lithiasis.—Not until the advent of radiography was it realized that urinary lithiasis in infants and young children is not an uncommon condition. Before then, it is true, vesical stone was recognized for generations, and its surgical treatment accorded a prominent place in the literature. Renal and ureteral calculi were considered extremely rare, and this is not surprising in view of the fact, that the diagnosis without the Roentgen ray is most difficult. That the condition is very frequently overlooked is seen by the statistics of Rafin.[14] He reports a series of 322 cases of renal calculus in infancy; 139 were found at necropsy; 140 occurred in infants under 1 year, twenty-six in children from 1 to 5 years. The small calculi so often present in infancy may be the basis of further trouble in later years.

Vesical calculus is a rather common disease in certain localities. Bokay[15] has collected 1,836 cases of stone in infancy and young children; 1,319 were vesical, one half were urethral, and nine were renal calculi. The diagnosis of vesical calculus offers little difficulty; the rather characteristic symptom complex immediately fixes attention to this region. Rectal pal-

14. Rafin: Ann. d. mal. d. org. genito-urin., 1911, 29, 481.
15. Bokay: Ztschr. f. Kinderh., 1912.

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pation should always be practiced, and has at times clinched the diagnosis. The stone searcher and cystoscope are valuable aids; the Roentgen ray is most important of all. Renal and ureteral stone offers more difficulties; for this reason Roentgen-ray examination should be used in a more routine manner. The presence of sand and gravel in the urine of young children, abdominal pain, spasmodic in character and accompanied by vomiting, are sufficient indications for radiography. Roentgen-ray examination should include the whole urinary tract, for stones may be located simultaneously in both kidney and bladder, as in the case to be reported.

CASE 5.—*Renal and vesical calculi.*—A. S., male, was admitted Nov. 10, 1915. The family history was negative. Patient had had measles and paratyphoid fever. Five weeks ago the child had a sudden attack of retention of urine; he was in another hospital for two weeks, no diagnosis being made. Nine days ago he complained of pain in the right side of abdomen, very intense at times, but does not radiate. There is no frequency or difficulty in urination; he has vomited twice. The mother has noted the urine is cloudy.

Physical examination revealed a well nourished child. The abdomen is lax and tympanitic. There is a definite small, tender mass deep in the right hypochondrium. Temperature ranged from 102:104. Urine—amber, cloudy, with a trace of albumin and many pus cells. Cultures—*Staphylococcus aureus.* On Roentgen-ray examination a triangular shadow is seen in the region of the pelvis of the right kidney. Both kidneys are enlarged. In the pelvis, in the region of the bladder, is another shadow which may be a calculus. A second Roentgen-ray confirms this examination, except that the shadow in the bladder region has moved.

A cystoscopic examination, under ether, was made by Dr. Beer. A calculus was seen lying on the floor of the bladder. Suprapubic cystotomy was performed by Dr. Beer. A stone the size of a cherry was removed.

Pyelotomy for right renal calculus: The pelvis was opened and a triangular stone removed. Patient had a rather stormy convalescence, developing a bilateral otitis media. The patient was discharged well, with wounds closed.

The second case of renal calculus was that of a child 6 years of age, whose chief complaint was nocturnal and diurnal enuresis. Roentgen-ray showed distinctly a calculus in the kidney. Cystoscopy was not done; operation was refused. The enuresis may have been due to the presence of the stone.

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Ureteral calculus is seldom encountered in early childhood, because the greater number of renal calculi are of small size, and spontaneously passed.

CASE 6.—*Ureteral calculus.*—P. E., female, aged 13 years, was admitted to the hospital March 15. Family history was negative. The present illness began three months ago with cramp-like intermittent pain in the right lumbar region. There was no urinary disturbance, no fever, chills nor hematuria.

Physical examination revealed a slight tenderness in the lower part of the right iliac region, otherwise negative. The urine was acid, clear, specific gravity 1.028. There were few white blood corpuscles and little epithelium. No red blood corpuscles. Roentgen-ray examination revealed two calculi present in the right ureter about 1 cm. from the orifice. Phenolsulphonephthalein, 45 per cent. in two hours. No red blood corpuscles were found in centrifuged specimens.

Cystoscopy and ureteral catheterization were performed by Dr. Beer. The bladder was negative except in the region of the right orifice, which is covered with muco pus.

In the right ureter an obstruction encountered at 2.5 c.m. was finally passed, and bloody urine obtained. No indigocarmin secretion in thirty minutes. The left ureter was catheterized. No obstruction encountered. The urine was clear, good indigocarmin concentration in twenty minutes. The injection of the right ureter with thoruim followed by radiography (ureterogram) demonstrates shadows to be in the ureter.

March 28, 1915.—Extraperitoneal ureterotomy was performed by Dr. Beer. Two stones were removed. Convalescence was normal.

COMMENT.—The importance of including the entire urinary tract in a radiographic examination is illustrated in the first case in which renal and vesical calculus were present at the same time. The diagnosis of ureteral stone was made on the Roentgen-ray examination, and confirmed by ureteral catheterization and the ureterogram. Of interest was the absence of red blood cells in the urine in a number of specimens.

Tumors of the Kidney.—The growths most frequently seen in childhood are sarcomata and mixed tumors. The former are probably more common, and are of greater malignancy. The majority occur in early childhood; in a collection of 130 cases, 106 were found in the first five years, and fifty-seven of these in the first two years of life.[16] Pain is a prominent symptom in sarcoma and is generally severe, whereas in the mixed form, it is only complained of very late

16. Holt: Diseases of Infancy and Childhood, 1903.

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in the course of the disease. The tumors rapidly invade neighboring organs, cachexia is rapid. Recurrences or metastases are the rule. The mixed type of tumor (Wilms[17]) are supposed to take origin in embryonic tissue, and are entirely different from other renal growths. They are composed of collections of epithelium, in the nature of tubular or glandular structures, and may contain besides smooth and striped muscle fibers, cartilage, fat, bone and proliferating connective tissue. The latter tissue is the one most frequently found. These tumors originate in the substance of the kidney, and grow directly into the parenchyma but do not infiltrate as the sarcomas or carcinomas generally do. Clinically, they are characterized by their large size (at times filling almost the entire abdominal cavity), absence of pain, and apparent good health of the patient. Often there are no subjective symptoms, and the growth is not discovered until it has reached a very large size. Metastases are rare, although the tumors are exceedingly malignant. The urine usually shows no changes; hematuria when present, is generally microscopic. The disease is most frequently seen in early childhood; occasional cases in the adult are reported. In a series of 165 mixed kidney tumors, 131 appeared within the first 6 years of age. Bilateral cases occur; Walker[18] reports ten instances in 141 cases. The prognosis is bad. Albarran[19] places the mortality from recurrence after operation at 86 per cent., Walker[20] at 93 per cent.

CASE 7.—*Tumor* (Wilms) *of right kidney.*—J. M., male, aged 17 months, was admitted Jan. 12, 1917. The family history was negative. The patient was breast fed and was normal at birth.

The child fell down a flight of stairs three months ago but sustained no contusions or lacerations; there was no bleeding. About two weeks later the mother noticed a hard mass

17. Wilms: Mischgeschwulste, Leipzig, 1899.
18. Walker: Ann. Surg., 1897, **26**, 585.
19. Albarran and Imbert: Les Tumers du Rein, Paris, 1903, p. 443.
20. Walker: Ann. Surg., 1897, **26**.

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in the abdomen. This has increased in size; the child does not complain of pain; there was no vomiting or fever. The bowels were regular.

Physical examination revealed a well nourished child. Occupying the right half of the abdomen is a firm, elongated mass, smooth, dull to percussion; the free border extends to the right iliac fossa; seems to be adherent.

The urine is cloudy, acid, no albumen, few white blood corpuscles and little epithelium. Roentgen-ray shows a hemogeneous mass occupying the entire abdomen and part of false pelvis; it cannot be determined roentgenographically what this mass is.

Cystoscopy under ether anesthesia by Dr. Beer. Bladder was normal. Left ureter discharging concentrated indigocarmin. Right ureterel orifice conld not be distinctly seen. No indigocarmin from this side during period of observation. Palpation under anesthesia; the mass feels nodular, movable and hard.

Nephrectomy for right renal tumor was performed by Dr. Beer. Transperitoneal incision, going through the right rectusmuscle, pedicle exposed, ligated and kidney removed. Normal convalescence, primary union.

Pathologic report—Wilms tumor.

COMMENT.—The interesting features of this case are as follows: Cystoscopy successfully performed in male child 17 months of age. The absence of indigocarmin secretion from the side of tumor helped to confirm diagnosis. Roentgen-ray examination was of no aid in determining nature of mass. There was no hematuria at any time, either microscopical or macroscopical. Ideal approach for large tumors is by transperitoneal route.

The second case was that of a child 3 years old who had two large hard kidneys. Diagnosis before operation was either bilateral polycystic kidneys or sarcomasa. The operation was more in the nature of an exploratory procedure; the sections removed were reported as Wilms tumor.

CASE 8.—*Sarcoma of kidney.*—F. A., female, aged 2 years, was admitted Dec. 16, 1915. Family history was negative. Patient had had pneumonia, measles and whooping cough. The present illness commenced six weeks ago with pain in the right hypochondrium. No radiation; no difficulty or frequency of urination. Mother noticed abdomen becoming larger.

Physical examination reveals a proturberant abdomen, with visible mass in right upper quadrant; mass is hard, reaches 1 inch below the surface of umbilicus, surface smooth. Axillary, cervical and inguinal glands enlarged. The urine is amber, acid, clear, specific gravity 1.016; moderate number of white blood corpuscles; phenolsulphonephthalien, 63 per cent.; urea, 10 mg. per 100 c.c.; urea, 36 mg. per 100 c.c.

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Roentgen-ray examination reveals a large, dense, homogeneous shadow which occupies the entire right side of the abdomen, and ends near the brim of the true pelvis. The shadow has the outline of an enlarged kidney.

Transperitoneal nephrectomy for sarcoma of right kidney was performed by Dr. Beer. Kidney firmly adherent; in removing, parenchyma was torn, and Sarcomatous tissue expressed. Radium applied through drainage tract for period of 4,067.5 mg. hours. Recurrence and death some months after.

COMMENT.—The diagnosis of sarcoma of the kidney is not difficult. Cystoscopy is generally unnecessary, except to determine the presence and functionating capacity of the other kidney. The Roentgen-ray examination in this instance was of considerable aid. The combined functional tests were normal, as is so often the case in renal tumors.

CONGENITAL HYDRONEPHROSIS AND HYDRO-URETER

This is not uncommon in infants and very young children. In a series of 500 cases[21] of hydronephrosis which came to operation, fifty-one were in children 1 to 10 years of age. A large number are found at necropsy — the congenital hydronephrosis of the newborn. The diagnosis may at times be difficult, as is shown by the following cases.

CASE 9.—*Congenital hydronephrosis.*—W. P., aged 3 years, male, was admitted to the hospital Dec. 8, 1916. Patient had malaria one year ago, measles six months ago. Has had poor appetite for the past year, not gaining weight; for the last ten days complains of hypogastric pains. His mother has noticed that the urine is cloudy.

Physical examination reveals a fairly well nourished child, with heart and lungs negative. Abdomen is lax, tympanitic; no dulness, no masses palpable, no tenderness. The liver, spleen, and kidneys are not palpable. The urine is cloudy, acid, specific gravity 1.020, with trace of albumen; many pus cells; negative for Tubercle bacilli.

The Roentgen-ray examination shows the left kidney somewhat enlarged, right kidney normal.

Cystoscopy under ether anesthesia, Dr. Buerger. Bladder was negative except for congestion in trigone; there was slight swelling around the left ureteral region. Indigocarmin seen emanating from right ureter, in good concentration in fifteen minutes, none from left side in thirty minutes. Note made at time: would advise another cystoscopy in a week

21. Küster: Chirurgie der Nieren, Stuttgart, 1902.

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If absence of secretion from the left kidney is confirmed, would conclude that sufficient evidence is at hand to warrant diagnosis of diseased kidney. Urethra is too small to admit smallest size catheterizing cystoscope.

At second cystoscopy one week later, these findings were corroborated, and immediately after examination the child was taken to the operating room.

Nephrectomy for congenital hydronephrosis and hydroureter, Dr. Buerger. Through a lumbar incision a considerably enlarged hydronephrotic kidney and ureter were removed; the ureter was the size of a small gut. Uneventful convalescence.

COMMENT.—This case presented no localizing symptoms or physical signs, so that it was impossible to determine which kidney was diseasesd. The Roentgen-ray gave the first clue as to the involved side, demonstrating enlargement of the renal shadow. Chromocystoscopy, from a diagnostic standpoint, gave almost as much information as ureteral catheterization.

The traumatic hydronephrosis occurred in a boy 10 years of age, and appeared after the child had been struck by an automobile. A large tumor in the loin was noticed. Cystoscopy demonstrated absence of secretion from the right side, good function from the left. At operation a large hydronephrosis was found. Nephrectomy, normal convalescence.

CASE 10.—*Diverticulum of bladder.*—M. B., male, aged 10 years, was admitted to the hospital March 15, 1915. The family history was negative. Patient had diphtheria at the age of 5. Five days before admission had terminal hematuria, and pain on urinating; has occurred several times since. Has some pain in hypogastrium, and feels he cannot empty his bladder. Patient is markedly pale.

Abdomen—slight tenderness in right costo-vertebral angle; right kidney palpable. Hypogastrium is filled by a globular mass which does not disappear completely after urination. Rectal—distended bladder is felt. Genitals—penile hypospadias. Urine—turbid; heavy trace of albumen; much pus and epithelial cells.

Phenolsulphonephthalein test: color first appeared in thirty-eight minutes; 45 per cent. excretion in two hours. Residual urine 100 c.c.; cloudy. Tubercle bacilli not found in urine.

Roentgen-ray examination negative.

Cystoscopy, under ether, Dr. Beer. The right ureteral orifice is patulous. Good indigocarmin observed in fourteen minutes. The opening of a diverticulum is seen in left bladder wall from margin of which indigocarmin issues. It seems therefore that the left ureter opens within the diverticulum, the mouth of which is thrown into heavy folds, which contract and relax.

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Cystography (argyrol) shows distinctly a diverticulum of the bladder, as large as a peach, and a dilitation of right ureter.

Extraperitoneal extirpation of diverticulum of bladder was performed by Dr. Beer. Diverticulum was found to compress both ureters, accounting for dilatation seen in Roentgen-ray. Diverticulum was excised. The left ureter was found markedly distended and intimately adherent to sac, so that about 1 inch of its lower end had to be excised; the proximal end was then implanted into the posterior wall of bladder. Uneventful convalescence; bladder control excellent.

Cystoscopy, forty-seven days after operation, shows the left (implanted) ureter in the median line, and functionating. Indigocarmin appeared in fair concentration in fourteen minutes, on right side in fifteen minutes. Site of diverticulum not visible.

COMMENT.—This case demonstrates the value of cystoscopy, and the cystogram. A diagnosis could not have been made without the aid of one or the other. Cystography supplements information obtained by cystoscopy, and gives important information concerning the size and shape of the diverticulum. Radiograms must be taken with the tube at different angles, otherwise the shadow of the sac may be superimposed on that of the bladder, and the diverticulum missed. Instead of thorium or the silver salts, a Roentgen-ray catheter may be introduced to outline the sac.

Of special interest was the cystoscopy undertaken six weeks after operation, which showed a functionating kidney on the side of the implanted ureter. This is probably one of the youngest cases of ureteral implantation on record.

SUBACUTE NEPHRITIS

Surgery for this condition should not be undertaken unless all medical means have been tried for some time and found ineffectual. The Edebohls operation is not curative; it is usually undertaken for the releif of general anasarca, or for impending uremia. The case in our series did not show any improvement after operation, and succumbed within a few days. Koplik[22] in 1911 reported a series of five cases in which the Edelbohls operation was performed with marked improvement in four.

CASE 11.—*Subacute nephritis.*—A. Z., female, aged 6 years, was admitted December 14. Patient has had measles. The

22. Koplik: Transactions of the Association of American Physicians, 1911.

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present illness began two weeks before admission with swelling of eyelids, followed by edema of legs and abdomen; urine was considerably diminished in quantity.

Physical examination showed a well nourished child with pronounced edema of eyelids, legs, neck, abdominal wall, and marked ascites. Urine—350:400 c.c. daily; many hyaline and granular casts, red blood corpuscles and white blood corpuscles. The child did not respond to any form of treatment; edema persisted, urinary output did not increase. Patient began to show signs of impending uremia.

Operation December 10th, bilateral decapsulation, by Dr. Beer. The kidneys were found enlarged and beefy red—typical decapsulation. The condition gradually became worse, and the patient died two days later.

COMMENT.—The diagnosis of this condition is simple and does not require instrumental examination. Despite the fatal termination of this case, numerous favorable reports have been published from time to time, and operation should always be considered, after all methods of treatment have failed.

CASE 12.—*Suppurative nephritis and perinephric abscess, congenital stricture of the meatus and urethra.*—J. R., male, aged 7 years, was admitted to the hospital Oct. 26, 1913. Had scarlet fever four years ago; three years ago had attack of difficulty of urination, with passage of blood and pus. One year later had a similar attack. The urinary stream was always small.

The present illness began four days ago with headache, fever, pain in the left loin, hematuria, and pyuria.

Physical examination revealed a pale, fairly well nourished patient. There was tenderness and swelling in left lumbar region. Temperature was 103 F. Genital examination disclosed a pin point meatus. Urine was acid, cloudy, specific gravity 1.014, albumen ++, full of pus and red blood corpuscles.

The diagnosis of a perinephric abscess was made, and the patient was immediately operated.

Incision and drainage of perinephric abscess, by Dr. Hyman. A large abscess containing thick pus was opened, the kidney was exposed, and a perforation in the cortex felt near its middle. Tube drainage. Culture of pus—*Staphylococcus aureus.*

After operation the patient developed convulsions and twitching of the face, legs and arm; then paralysis of these parts; all disappeared in one day, and were considered uraemic. Temperature dropped to normal; the urine, however, still continued turbid, and contained considerable pus; the wound discharged profusely. Thorium injected into the bladder, was found to run up the left ureter, demonstrating a patulous ureteral orifice. Phenolsulphonephthalein 65 per cent.

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Operation, November 7, Nephrectomy for suppurative nephritis. The kidney was found completely disorganized and studded with multiple suppurative foci; extirpated. Meatotomy was then performed and instruments up to F. 15 were passed. Uneventful recovery.

COMMENT.—The long duration of the kidney lesion dating back three years before operation, the pin point meatus which may have been one of the ethological factors, the transient uraemic manifestations, the perforation of a cortical abscess, with subsequent formation of a perinephric abscess, the patulous condition of the left ureteral orifice, causing a reflex up into the ureter, were the interesting features of this case.

CHRONIC RETENTION OF URINE IN CHILDREN

Under this heading are included patients suffering from chronic vesical retention due to various etiologic factors. The condition receives but scant attention in the literature, sporadic cases being reported from time to time. Beer[23] recently published a series of nine cases, and calls attention to the fact that the disease is often unrecognized until a late stage has been reached. The clinical picture is fairly characteristic; the patients have the pale, pasty appearance of chronic nephritis. Difficulty of urination often accompanied by straining, is an early symptom. The bladder is regularly found distended, at times reaching above the umbilicus. Residual urine is present in large amounts. On palpation the bladder can be felt to contract and become hard. The urine is clear in the early stages, but as a rule, becomes infected later on. As a result of back pressure dilatation of the ureters and pelves develop; this can readily be demonstrated by thorium cystograms. Cystoscopy reveals a trabeculation of the bladder with patulous ureteral orifices. Functional tests demonstrate marked renal impairment. Neurologic examination of these patients often shows nothing abnormal, in others distinct evidences of spinal cord or brain lesions are found. In the neuromuscular type instruments pass readily into

23. Beer: Chronic Retention of Urine in Children, THE JOURNAL A. M. A., Nov. 13, 1915, p. 1709.

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the bladder without encountering an obstruction. The etiologic factors have been tabulated by Beer as follows:

1. Mechanical obstructions: (*a*) Extravesical, as congenital folds and strictures, including tight prepuce, small meatus, new growth. (*b*) Intravesical, as diverticulum of bladder, vesical stone.

2. Neuromuscular: (*a*) Brain disease; (*b*) spinal cord disease; (*c*) spasticity of sphincter without definite neurologic signs, probably disease of spinal cord.

The prognosis varies with the type; when due to mechanical factors, surgical procedures are often curative. The neuromuscular group all terminate fatally, generally from renal infection and insufficiency. Operation is only palliative—cystotomy for bladder drainage—and nephrotomy when the kidney becomes infected.

CASE 13.—*Chronic retention; hypertrophied bladder; bilateral hydronephrosis.*—Boy, aged 15 months. Physical examination reveals a globular tumor mass in the hypogastrium. It is always present except when emptied by a catheter, that is, distended, hypertrophied bladder. In left lumbar region is a mass corresponding to the position of the kidney. This is probably a hydronephrotic organ. No neurologic symptoms were elicited.

Cystoscopic examination (February, 1912) reveals bladder trabeculated, otherwise normal. No obstruction in urethra. Indigocarmin does not appear until four and three-quarters hours after injection, which suggests a bilateral kidney involvement.

Diagnosis of chronic retention, hypertrophied bladder, bilateral (probably) hydronephroses, due to spasm of vesical sphincter.

PYELONEPHRITIS

It is often difficult, especially in the chronic forms, to differentrate between pyelitis and pyelonephritis. In fact it has been claimed that there is always involvement of the renal parenchyma in pyelitis. In the acute stage, the clinical manifestations of a pyelonephritis are more pronounced; the fever is higher and remittent in character, and apt to be accompanied by chills; the local signs, tenderness and pain more

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marked. Pus is present in the urine in varying amounts depending on the location of the abscess. If in the cortex, pyuria may be absent or insignificant. Of considerable diagnostic aid in differentiating these conditions is the late appearance in the urine of blue colored pus after the administration of methylene blue or indigocarmin. Weeks, and often months after, one or more specimens of urine may suddenly become stained blue, due to the rupture into the pelvis of parenchymatous abscesses which have stored the dye. Beer,[24] who first called attention to this phenomenon, described cases in which methylene blue was excreted as long as two and three-fourths years after its administration.

CASE 14.—*Right pyelonephritis.*—P. T., a female, aged 6 years, was admitted June 10, 1916. Family history was negative. Two months ago patient had bullous eruption on the body. One month ago double otitis media and mastoiditis. Patient's urine has been cloudy for two years; complains of frequency of urinations—every 1 : 2 hours for a few months; for the past few weeks has had pain in right lumbar region. Pain, tenderness and resistance in right flank.

Temperature fluctuates between 99 and 105 F. No chills. Urine is cloudy, specific gravity 1.020, full of pus. Von Pirquet test was negative, Roentgen-ray negative, Tubecle bacilli negative.

Cystoscopy (Dr. Hyman). The bladder was diffusely inflamed; the right ureteral orifice swollen, the left normal. Both ureters catheterized—no obstruction. Right kidney—fair indigocarmin concentration in twenty-five minutes; catheter becomes clogged with pus; few c.c. urine obtained. Urea 1.1. Many white blood corpuscles. Left kidney—indigocarmin good concentration, twenty minutes. Urea 0.9; occasional white blood corpuscles.

The child was placed on large doses of urotropin. At varying intervals two, three and six days, and two weeks after injection of indigocarmin, after the urine had been clear, the blue color suddenly appeared in one or two specimens. Temperature gradually came to normal, and pus disappeared from the urine.

Cystoscopic examination (Dr. Hyman) before leaving the hospital, showed very slight cystitis, no pus in catheterized specimen.

24. Beer: The Diagnosis of Pyelonephritis, THE JOURNAL A. M. A., June 8, 1907, p. 1936.

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COMMENT.—The sudden appearance of blue in the urine weeks after the injection of indigocarmin, was undoubtedly due to the opening of small abscesses into the pelvis. Coincident with this, the temperature dropped to normal, and the urinary conidtion improved considerably.

The other two cases of pyelonephritis in this series were bilateral, and occurred in female children 22 months, and 4 years old, respectively. Both were catheterized, pus obtained from each kidney, and colon bacillus found in culture in each instance.

CASE 16.—*Retroperitoneal tumor.*—The following case is cited to illustrate the value of cystoscopy as an aid in differentiating an extravesical from an intravesical condition.

The patient was a male, 3½ years of age. Six days before examination a large mass was accidentally noted in the hypogastrium. The mass was hard, solid, nodular, extending from below the umbicilus well down into the pelvis. The question arose whether this tumor was a vesical or prostatic neoplasm or retroperitoneal growth. Cystoscopy (Dr. Beer) demonstrated a normal bladder; both ureteral orifices were normal. Indigocarmin appeared in good concentration from both sides in 12 minutes. The diagnosis of retroperitoneal tumor was made.

CONCLUSIONS

Urologic diseases in children are not as infrequent as we are led to believe. Many of the cases in this series would undoubtedly have been overlooked had not the methods of examinations commonly employed in adults been used. The feasibility of cystoscopy in very young patients, and its practical value is amply illustrated by a study of the case reports. Too much stress should not be placed on negative urinary findings. Cystoscopy will at times be indicated despite the absence of abnormal constituents in the urine. Of the functional tests, indigocarmin is the simplest in application, and is generally reliable. Its use, combined with the observation cystoscope, will often render catheterization of the ureters unnecessary. Phenolsulphonephthalein and the blood tests (urea nitrogen) are seldom indicated, unless from a prognostic standpoint. Radiography should be more frequently resorted to, and should precede every cystoscopic

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examination. In obscure vesical conditions, especially when cystoscopy is contraindicated or cannot be performed, cystography will often be found to give valuable information. The proper application of the methods enumerated will seldom make it necessary to resort to exploratory operations on the urinary tract for diagnostic purposes. Operative procedures on the kidney, ureter or bladder are well borne in infancy and early childhood; in a series of over twenty-five major operations, there was but one immediate death, that due to uremia following decapsulation for subacute nephritis.

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ABSTRACT OF DISCUSSION

Dr. Leo Buerger, New York: Taking up seriatim some of the conditions in which cystoscopic findings in children are reported by the speaker, my own comments would be as follows:

First, as for the cases of perinephritic exudate, it appears to me that in most instances cystoscopy is unnecessary, and that the diagnosis can usually be made without the application of this rather laborious method.

Second, in tuberculosis of the kidney I believe that cystoscopy is not only exceedingly valuable, but often indispensable. Of the three cases mentioned by the speaker two patients were cystoscoped by me and the diagnosis definitely established by the cystoscopic findings. In the first of these, a boy of 10, the diagnosis of tuberculosis of the kidney was made on the presence of a "golf-hole" ureter and the evacuation through the ureteral catheter of purulent urine containing tubercle bacilli. In the other case, a boy of 11, I made the diagnosis on the presence of a stricture of the ureter, inability to catheterize the ureter, and the presence of tubercle bacilli in the bladder specimen.

Third, as for vesical calculi, if rectal palpation does not suffice, and if the roentgenogram is negative, I would be rather in favor of the use of the cystoscope than of the stone searcher.

Fourth, in the case of tumors, most of which are distinctly palpable—for they usually attain considerable size before the patient comes under observation—cystoscopy is valuable for the purpose of ascertaining the condition of the other kidney.

Fifth, the case of congenital hydronephrosis mentioned was also cystoscoped by me, and occurred in a boy of 3. Here observation cystoscopy was sufficient to establish the diagnosis

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of involvement of one kidney, demonstrating the absence of flow from the affected side and the absence of indigocarmin, the presence of renal infection being determined by the presence of pus in the urine, without evidence of cystitis.

In 1914 I reported a case of bilateral congenital hydroureter and hydronephrosis (*International Clinics*, Series 24, 1914, 4.) in which the suspicion of the presence of dilated ureters was entertained by me owing to the presence of dilated ureteral orifices, in the case of a boy of 6. I believe that the ureterogram and the pyelogram of this case obtained by me in 1912 by means of the introduction of argyrol into the bladder, with the patient in the Trendelenburg posture, were among the first, if not the first, to show the value of this method in the diagnosis of dilated ureteral orifices.

In conclusion, I shall mention but one of my many cases which will demonstrate that the cystoscope and ureteral catheter have also a therapeutic field of application.

In a girl 6 years of age (I. H.) who was referred to me in January, 1917, with the diagnosis of recurring pyelitis, cystoscopy revealed stenosis of the lower end of the right ureter. With the ureteral catheter the obstacle was overcome and purulent urine obtained from the affected side. Lavage of the ureter and pelvis on two occasions completely cleared up this case, in which there had been an elevation of temperature for several weeks before she came under my observation, and purulent urine for more than a year. A recent report from her physician says that the patient has had no recurrence.

Dr. H. L. Kretschmer, Chicago: At the Children's Hospital we have cystoscoped approximately fifteen patients in the last two or three years. We have been using as a routine the ordinary pharyngoscope which the nose and throat men use. The youngest patient we cystoscoped was a girl aged 18 months, and it worked very well. In two instances in patients who were in the hospital for other complaints, including enuresis, we cystoscoped the patients and found calculi in their bladders. In one instance of painless hematuria in a boy of 5 we found a large angioma in the bladder. In the cases of kidney tumor we have been doing the same thing Dr. Hyman has, namely, plain cystoscopy with chromocystoscopy by means of indigocarmin. In some of the cases we have tried to catheterize both ureters, for which we used the ordinary child's cystoscope, single catheterizing, withdrawing the cystoscope, leaving the catheter lie, and introducing the cystoscope a second time, believing this a simpler method than to give a second anesthetic. One child of 3 suffering with pyelitis was treated by pelvic lavage and cured.

We have taken some cystographs in children and have found in some that the urteral orifice was not perfectly tight and there was a regurgitation of the fluid into the renal pelvis. In one case in which the bladder capacity was 12 or 14 ounces the patient had no relaxation of the

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ureteral orifice. I see no reason why cystoscopy, catheterization and cystography should not be done in children as well as in adults. The only objection I can see would be the use of an anesthetic, which I do not think is very serious in children.

Dr. Martin Krotoszyner, San Francisco: I fully indorse Dr. Buerger's statement that nephrectomy in renal tuberculosis of small children should, wherever feasible, be done, on the basis of previous cystoscopic evidence, and I recall in this connection the case of a boy of 9 in whom I was able, by bilateral ureteral catheterization, to obtain complete data on his comparative functional and anatomic renal condition, after which nephrectomy was followed by permanent recovery.

That cystoscopy should, if possible, be practiced in all diagnostically obscure urologic lesions of children was brought home to me by the following case: Last fall I saw a girl of 6 who was suffering from acute left-sided septic nephritis, consecutive to influenza, and in whom, as the child's condition necessitated immediate surgical attention, nephrotomy was performed, on the basis of the clinical findings. The evidence which could have been obtained by ureteral catheterization at first hand would have proved the necessity of primary nephrectomy, while removal of the affected kidney had to be done within a week after the first operation as a measure of last resource.

Dr. William F. Braasch, Rochester, Minn.: Fortunately, surgical conditions in the urinary tract of children are comparatively rare, and then occur, in the majority of instances, in the first two or three years of life, when cystoscopy is impractical. The so-called congenital malignant tumors of the kidney usually end the life of the child early and surgical proceedings are of no avail. In male children under 5 years of age cystoscopy cannot be performed with the catheterization attachment without considerable trauma. In the female child, however, such an instrument can be used without causing any damage. The cystoscope should be used more frequently in the treatment of pyelonephritis of young children. With many of these children the renal infection lingers for many years and can often be cured by pelvic lavage. The fact that pyelonephritis occurs more often in female children makes the method more applicable.

Dr. C. G. Bandler, New York: About two months ago I was called on to examine an unusual case at the New York Post-Graduate Hospital. The patient was a boy, 4 years old, who had an abdominal tumor. The surgeons were unable to determine whether it was a tumor of the bladder or an intestinal tumor impinging on the bladder in some way. With a No. 12 F. single catheterizing cystoscope I was able successfully to examine this child and found a mass in the left side of the bladder. I was also able to catheterize the left ureter. Resection of the bladder was subsequently performed suc-

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cessfully. We removed one-third of that boy's bladder. This was about two months prior to this meeting. The boy left the hospital and has since been in very good condition. We have examined him two or three times, once under anesthesia, with a cystoscope which is very small, and found that the ureter, which was implanted in the upper part of the bladder, was functioning well.

Dr. Abraham Hyman, New York: Not all of the cases described in this paper required cystoscopic examination to corroborate the diagnosis. In perinephric abscess and in tumors of the kidney or hydronephrosis where there is considerable enlargement of the kidney the diagnosis can generally be made without cystoscopic examination. Cystoscopy, however, is of importance in determining the presence and function of the second kidney.

I agree with Dr. Braasch that very young boys cannot always be catheterized, even with the small instrument described. Catheterization, however, is not necessary in the majority of instances; observation cystoscopy with indigo-carmin (chromoureteroscopy) suffices.

The case of diverticulum of the bladder was of considerable interest. The patient, a boy of 8 years, had a successful ureteral implantation performed. The lower inch and a half of the ureter, which was firmly adherent to the sac, had to be sacrificed and the distal end implanted into the posterior wall of the bladder. Cystoscopy two months later showed a functionating kidney.

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POLYCYSTIC KIDNEY

CHARLES E. BARNETT, M.D.
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In my former articles on this subject[1] four and three years ago the former dealt especially with the unilateral form of polycystic kidney and its etiology. The latter was a publication of personal statistics gathered from an extensive correspondence with the surgical world of North America.

This paper is merely a continuation of those statistics with the addition of new material found during the interim.

The effort has been to collect facts rather than fiction, so in this report, in its compilation, when the statistics sent seemed ambiguous or fictitious they were excluded.

It appealed to me that two of the most important proofs to be made regarding polycystic kidney disease are:

Does it occur truly unilateral? Is it always congenital or does infection figure as an etiologic factor in the disease?

In order to get a postmortem view, the anatomists and pathologists of the Class "A" universities were written to with considerable success. The effort to get postmortem reports from nephrectomized polycystic kidney cases met with less success.

While unilateral polycystic kidney as designated today means unilateral macroscopically or by palpation, it is a fact, however, that to be truly so the kidney tissue must be proved microscopically free from any cystic changes, and until this is done we have missed our proof positive.

1. Barnett, C. E.: Unilateral Polycystic Kidney, Tr. Am. Urol. Association, 1913. Polycystic Kidney, Surg., Gynec. and Obst., December, 1914, p. 753-756.

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The question of infection is still debatable. Men from some of our best clinics are positive that infection is not a factor, yet equally prominent men report infections in their recent case reports.

It has, however, a much better chance of solution today because the larger clinics are now watching that phase of the disease also.

From a diagnostic standpoint, the use of collargol in pyelography, in polycystic cases, has been condemned by a number of men in their reports, as being dangerous. The simple leaded catheter is used in preference.

My findings of the reports on the operative procedure done recently on polycystic kidneys were nephrectomies, 163; Rovsing's puncture, 30; exploratory incision, 27. Some were found reverting back to nephrectomy following puncture, and vice versa.

Mortality has been greatest following the puncture operation; however, a comparison from that standpoint might be unjust when one considers that the more hazardous cases would receive that form of treatment. I am of the opinion, though, that the functional findings of the kidney should decide the surgical procedure taken. For instance, Dr. J. J. Buchanan of Pittsburgh, in an admirably complete history report of three operative cases since April 1, 9115, gives the postoperative findings of a left polycystic case operated on in August, 1916, by the puncture method. One month later both ureters were catheterized, a dry kidney on the left side being found, but with a normal flow from the right.

With the final findings corresponding to this case, one would regret that a nephrectomy had not been performed in spite of the added shock, and I am not so sure that the trauma of nephrectomy is greater than the added time of anesthesia for the time-consuming puncture method. Puncture would appeal to me to be indicated where the tumefaction was equal in both kidneys and their weight was a menace to the patient

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or when the kidney, in spite of its enormity, showed a function of value.

The conservation of the scanty renal tissue remaining following a puncture operation, whereby the maximum functional possibilities are sustained, is well illustrated in a report from Dr. Gaston Torrance of Birmingham, Ala.

This case, a male, aged 40, is reported in my former report as unilateral polycystic kidney. Nephrectomy was done on the right side; recovery was complete. There were no symptoms for five years, at which time anuria occurred for seven days, followed by a health period of six months. Streptococcic infection was now present for fourteen days followed by a seeming recovery. Six months thereafter anuria occurred for six days at which time a retention ureteral catheter was placed and under spinal anesthesia a puncture of the cysts was done, followed by a practically normal secretion of urine for five days when anuria returned without, however, uremic symptoms. The ureteral catheter was removed; the kidney was opened into the pelvis and a drainage tube introduced through the loin. The kidney again began to secrete and sustained life for two weeks longer.

Because of the remarkably small amount of kidney necessary to sustain life, these polycystic cases should not be abandoned until the last vestige of renal tissue is shown to be consumed.

Under the question of heredity, Dr. F. Robert Zeit of Chicago gives a most voluminous occurrence with three generations. He cites specimens of a 40-year-old mother and 1-year-old baby, both having bilateral polycystic disease, her father having died from polycystic kidney disease; all her living children (four) are now suffering from kidney disease, presumably polycystic.

An obstruction case of the new-born, while not particularly rare, was reported by Dr. Burton C. Hirst of Philadelphia, which necessitated bilateral puncture before delivery could be accomplished.

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The pathologists almost unanimously adhere to the "congenital cystic kidney" nomenclature in spite of the fact that "polycystic kidney" was the name most favored by a majority of surgeons.

There is no name that will fit the disease perfectly, for "congenital cystic kidney" would hardly describe those patients dying from polycystic kidneys after the age of 65 or 76 unless they were proved to be polycystic from birth.

Large solitary and small multiple retention cysts of the kidney are separate individual entities within themselves, even should they belong to polycystic disease. Echinococcic cyst is an entirely separate disease with a specific cause.

"Polycystic kidney" would seem to describe the pathology best unless all cases are proved congenital.

It has been observed in the reports now received that the surgeons show more hesitancy in specifying unequivocally unilateral polycystic kidney.

In my investigation in 1912 the reports of the large number of unilateral cases from so many thoroughly reliable surgeons made me conclude, naturally, that unilateral cystic disease was not rare. Since then I have followed these and other cases diligently, whenever traced, hoping to find unilateral cases following the nephrectomized, punctured or nonoperated unilateral cases reported. I am still looking for the first one.

With this finding, one would be inclined to entirely reverse his opinion and conclude that unilateral polycystic disease did not exist.

If that were true congenitality would be the etiologic factor in all the cases, with syphilis as one of the most favorable possibilities, directly or indirectly. The misjunction between the secreting and excreting tubules (anlagherung zone) could be caused by syphilitic abnormality through heredity or by destruction by way of the maternal hematogenous spirochetes, thereby producing arrested development, tubular and connective tissue destruction, which could be followed by any

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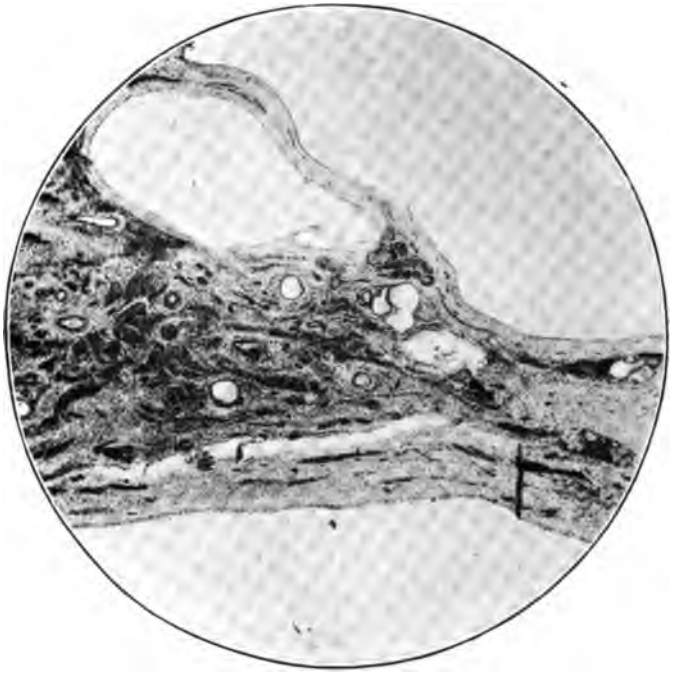

Fig. 1 (Case XIV-160).—Section from left polycystic kidney; a field containing part of a large cyst which is separated from a smaller cyst by thin wall tissue. Kidney substance shows an extreme fibrosis with scarcely any evidence of kidney structure. There are occasional remnants of tubules and glomeruli buried in the connective tissue which lies between the cyst walls.

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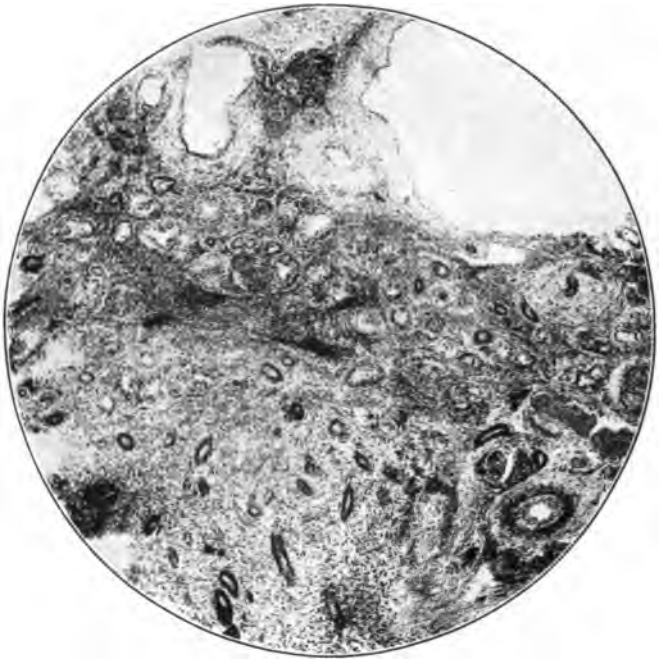

Fig. 2 (Case XIV-160).—Section from right, so-called normal kidney. This photomicrograph is practically analogous to its fellow, the left (Fig. 1), with the exception that fibrosis is not so far advanced. Note the cysts, then a more vitalized field with a few scattering glomeruli and tubuli, then a fibrotic field with a few seemingly straight tubules that are being squeezed out by the fibrosis.

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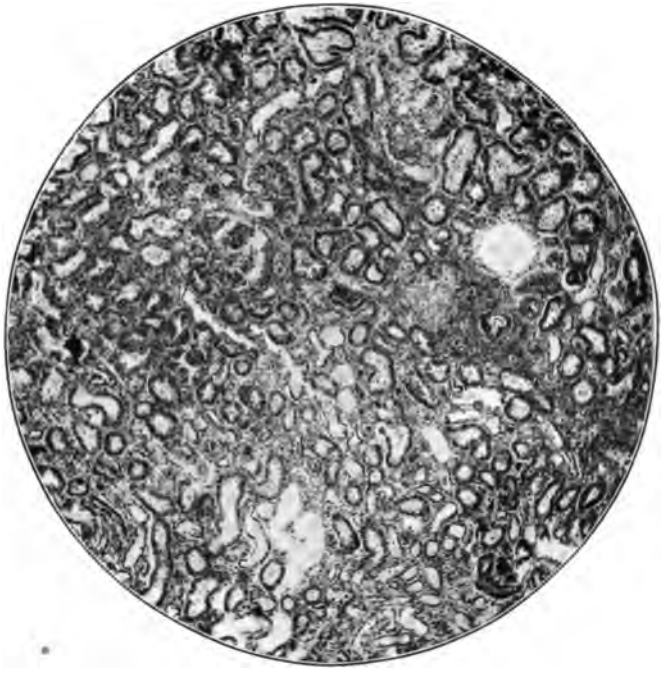

Fig. 3 (XIX-134).—Section from so-called normal right kidney. A solitary cyst was found within the whole field; however, the specimen is not polycystic, neither is the kidney normal. The section shows vascular changes with thickening of the vessel walls and associated areas of fibrosis, a moderate degree of round cell infiltration, of hyalinized glomeruli and of thickened glomerular capsules. Photomicrograph shows thickened arteries, glomeruli with thickened capsules, tubular destructive changes and moderate fibrosis or increase of connective tissue.

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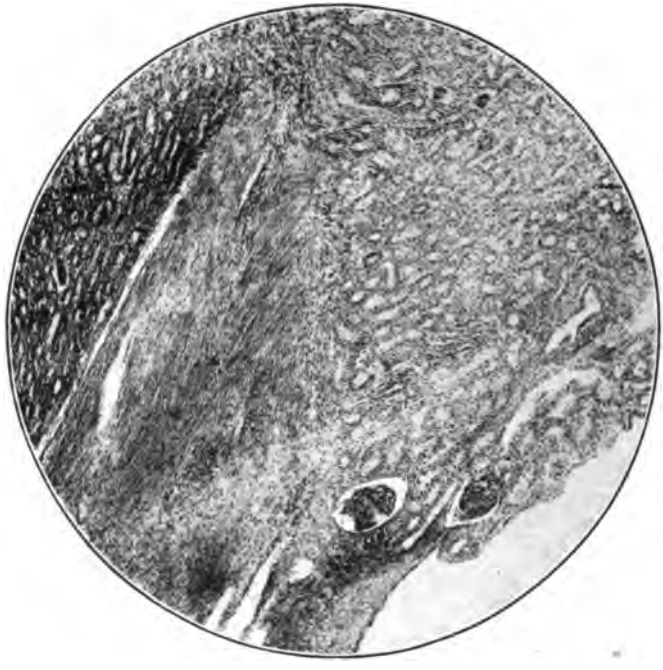

Fig. 4 (the author's case 333-M).—Section from an almost totally destroyed polycystic kidney. Cyst cavity shows on the edge of the picture. Two well-marked glomeruli are seen near the edge of the cyst cavity comparatively normal in appearance. Note the wedge shaped fibrosis extending into the tubular field, also the seeming normalness of the tubular tissue immediately adjacent to the scar or wedge fibrosis. It is interesting to note this sharp vital line or normal tissue near the fibrotic zone, in all the adult polycystic kidney sections whereby function seems to be active even in the smallest areas of nonfibrotic tissue.

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of the natural end results such as tubular block, cystic pressure block, inflammatory changes with fibrosis especially pronounced in its pressure necrosis in the medullary zone.

While bilateral bacterial infection could be possible through the maternal circulation, the history of the unilateral tubercular kidney as primarily the rule would indicate a selective degree or resisting quality that kept the one kidney free from destruction; it is known, however, that maternal infections such as skin rashes are hematogenously carried to the fetus and during this time bilateral renal invasion would naturally occur. While it would seem unlikely, yet papillitis, tubular nephritis, fibrosis, in fact all nephritic changes could take place prenatal.

Of the nine living unilateral patients in my last report five developed polycystic changes in the remaining kidney, thus indicating that possibly all of the unilateral reports will eventually become bilateral. This was exemplified in the unilateral case reported by Johnson in volume 3 of his work on Surgical Diagnosis. A letter from him telling me that the remaining kidney had become polycystic caused me to change his case to bilateral in my former report. In my own case reported as unilateral I fear the remaining kidney is undergoing cystic changes in spite of the fact that her health just now is comparatively good. Notwithstanding the conservation of her body against renal functional excess there is a decrease of 22 per cent. in the phenolsulphonephthalein output compared with five years ago with pressure pain in the kidney region and considerable tumefaction felt.

Of the four so-called unilateral postmortem cases reported by one of the Class "A" universities, the specimens of two were fortunately saved.

XIX-134, man, aged 60 years, congenital cystic kidney. Right kidney and liver normal.

XVI-160, congenital cystic left kidney with tortuous ureter in new-born with right kidney and liver normal.

Sufficient material from the so-called normal right kidney of the first case (XIX-134) and from both kid-

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neys of the second (XVI-160) case was sent me for microscopic sections (See Figs. 1, 2 and 3).

Before having the sections made, however, I wrote the pathologist for his word to vouch, for me, that there was no reason to doubt that the material might have "become mixed" in the laboratory. He was able only to vouch for the (XVI-160) new-born patient, which he assured me was removed by his own hands.

As this so-called unilateral specimen proved polycystic (Fig. 2) it showed that our extra precaution was unnecessary.

In the case of the man of 60 years (XIX-134) the kidney was not normal (Fig. 3) and could easily have been a chronic nephritic specimen mislabeled in the laboratory.

The marked analogy between the right and left kidneys of the new-born babe cases (XVI-160) shows an added interest in the polycystic metamorphosis in utero. The sparsity of glomeruli and extensiveness of the fibrosis, with no zone of richness in any portion of the field, is in marked contrast to the adult (my Case 333-M, Fig. 4) where the fibrotic field will be surrounded by normal kidney substance. The cyst cavity capusule hardly finished before seemingly normal tubuli begin, tubuli even being found in the delicate connective tissue divisions between the cysts.

Leukocytic infiltration was found present in all the sections examined. No active infection was found in any of the sections.

The tortuous ureter, in patient XIX-160, new-born, exemplifies argument toward Bard's[2] contention of the "Idiopathic Dilatation of Parts of the Urinary Apparatus."

He claims that "the polycystic kidney is the manifestation of the trouble when it affects the glomerular-tubuli apparatus, but megabladder, megapelvis, and the more generalized form, cystohydronephrosis, are likewise tangible evidence of this anomaly."

2. "Idiopathic Dilatation of Parts of the Urinary Apparatus," Ann. de Med., Paris, November-December, 1916.

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SUMMARY OF STATISTICS

The following is a general summary of my statistics gathered to date:

Whole number of polycystic kidney cases reported, 422; 291 were bilateral; 131 unilateral.

Of the nine unilateral cases, where nephrectomy was performed, reported in my former paper, five patients are still living, one after four years and eight months; one after five years; one after seven years; one after nine years; one after ten years.

The postoperative life of the patients who died was 18 years, 8 years, 6 years, 1 year, 9 months.

One hundred and fifty-eight had operative recoveries and 142 died. Still living 202 (115 cases untraced). Operated 220; (nephrectomy, 163; Rovsing's puncture, 30; exploratory incision, 27); not operated 124.

Congenital defects associated with cysts of the liver, etc., were reported as follows: cysts of the liver, 17; cysts of the liver and spleen, 2; cysts of mammary gland, 2; cysts of thyroid gland, 2; multiple cysts of the ovaries, 1. Associated with renal calculi, 3. Heredity was a factor in 14 cases.

The urinary tract was infected in 43 cases; noninfected, 51. These infections comprised mixed, colon bacilli and pneumococci.

Fifty-one males and seventy-nine females were reported. The youngest (outside of two new-born and one fetus) was 1 year; the oldest 76 years. The disease occurred most frequently between the ages of 40 and 50 years. The average age of the males was 42; females, 39.

In other cases traced, the following lengths of time had elapsed, following the postoperative recovery, with the patient either still living or dead:

Unilateral		Bilateral	
No.	Years	No.	Years
1	25	1	6
1	14	1	4
1	12	1	3
1	11	1	2
2	10	1	1⅙
3	9	1	1
1	8		
1	7.5		
1	7		
3	6		
2	5		
3	4		
1	3⅙		
2	3		
1	2.5		
1	2		
4	1		
2	¾		

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New cases since last report, 47; 41 were bilateral; 6 unilateral.

Number of unilateral changed to bilateral since last report, 10.

Total number of postmortems held on polycystic kidneys, 104, all bilateral.

Out of 10,761 postmortems reported from four of our Class "A" universities, 41 polycystic kidneys were found (one in 269); all bilateral.

Five of the polycystic cases were accidentally found at necropsy.

CONCLUSIONS

Polycystic kidneys show the ear marks of congenitality and heredity.

There is proof positive that polycystic kidney disease occurs during fetal life; on the other hand, there is no substantial proof that it may not be acquired during adult life. However, the congenital bilateral form is the usual form of the disease encountered.

That a vast number of postoperative polycystic cases are untraced.

That the puncture operation is being done more than heretofore, and that much good can be done to conserve the remaining kidney tissue by relieving the pressure by puncturing the polycysts.

That when the function of the kidney is nil, nephrectomy rather than puncture is indicated.

That all unilateral diagnoses made and proved to date, were macroscopic or by palpation with a final bilateral termination.

While notwithstanding the constant destruction going on within the kidney from polycystic disease itself, there are still further changes taking place on account of acidosis, faulty diet, violent exercises, etc., that is quite amenable to correction. So in order to get the most service from the standpoint of health and longevity in these cases the kidney tone should be tuned to its greatest efficiency and in that way conserve renal destruction.

The question of definite etiology of polycystic kidney is still a part of the future.[3]

3. Any one reading this article who has recently performed a postmortem in a unilateral polycystic case would confer a great favor on me by forwarding a section of both polycystic and normal kidney.

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ABSTRACT OF DISCUSSION

Dr. Robert C. Bryan, Richmond, Va.: Apparently the point that interests us here is not the diagnosis or the treatment, but the etiology, and I thought it would be of interest to try to trace it. It is known that this condition is found in several members of the same family, and that it is associated with other anomalous conditions, such as Dr. Barnett referred to—ovarian cysts, cysts of the liver, cysts of the ovary, even harelip, atresia, etc. It is known also to be more frequently found in women than in men, in the proportion of seven to five. It is more frequently noticed on the left side than on the right side, and is usually observed in adult life between the ages of 40 and 50. Some enterprising microscopist found out that there were 4 million tubules in the kidney and that each one secreted during a normal life from 8 to 10 c.c. If this calculation were carried along a little further we would find that the normal man in fifty years secretes about 145 barrels of urine, each barrel containin 50 gallons. Most of these little multiple cysts, which are likened to a bunch of grapes, but which I should liken to a bowl of soapsuds, some larger and some smaller, all glistening, would, I venture to say, contain about 8 to 10 c.c. Some get very much larger. That is due to interstitial hyperplasia. There are several theories about this. There is the congenital theory, the inflammatory theory, and the neoplastic theory. The congenital theory is that of a failure of union between the renal vesicles, on the one side, and the pelvic portion of the Wolffian duct, on the other. This is probably the most pausible explanation. Virchow's theory has, I think, been thrown out. The neoplastic theory of adenoma, I fancy, also does not hold, as this condition occurs later in life and does not show itself early. The interstitial hyperplasia that is developed between these cysts produces the uremia, which is the immediate provoking cause for surgical interference.

I do not know but that all cases are really histologically bilateral. Richie, in 1876, found only three that were unilateral. Dr. Barnett reports that ten more of the cases that were thought to be unilateral were found to be bilateral, so that apparently the condition is a failure of the anlage to meet properly the tubules and a constant backing up; this ultimately spells uremia.

Dr. Anton G. Rytina, Baltimore: For the benefit of Dr. Barnett's statistics I should like to add a case of double polycystic kidney that I saw. This case was interesting because it showed the value of renal functional tests. One of the general surgeons at the Mercy Hospital said the patient had undoubtedly a kidney tumor on the left side, and a phenolsulphonephthalein output of 15 per cent. The patient's symptoms were polyuria, no hematuria, urine perfectly clear,

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low specific gravity, a trace of albumin, no casts. A shadow was seen on the right side, the opposite side to the kidney tumor, and this was diagnosed as a stone in the gallbladder. We catheterized the ureters and found that the function on the supposedly healthy side was one quarter that of the diseased side. I made a diagnosis of double polycystic kidney, and told the surgeon that if he must operate I should advise him to operate on the right side, as the supposedly diseased side showed a function four times that of the opposite side. He thought this diagnosis was a little too keen, and decided to perform an exploratory operation. He opened the abdomen and verified the diagnosis. There was a double polycystic kidney and a stone in the right kidney. I should like to ask Dr. Barnett if stone is a very frequent complication of polycystic kidney?

Dr. B. A. Thomas, Philadelphia: About three years ago it was my fortune to have a woman 30-odd years old referred to me for pyuria, with some symptoms of dragging pain in her right loin. She had also, in addition to this, a moderate exophthalmic goiter. The indigocarmin test showed that there was a deficiency of function on the affected side, with normal output on the other. The tentative diagnosis was hypernephroma, or mesothelioma. Operation, however, revealed that the tumor was a polycystic kidney. In view of the excellent function on the other side, I removed the kidney. It was tremendous in size, extending well down into the pelvis. There were certain pathologic features about the kidney which to me have always been interesting. In most congenital bilateral polycystic kidneys which I have seen the cysts have been scattered uniformly throughout the organ. In this case the cysts were in the lower three fourths of the kidney, the upper pole being normal. It has always seemed to me that in this case I had to deal with a unilateral polycystic kidney, realizing of course that as a rule these polycystic kidneys are bilateral and congenital. The peculiar distribution of the cysts in this kidney may present a pathologic picture of significance. The patient made an excellent convalescence. It is three years since operation, and she is in excellent health, no evidence of cystic degeneration of the remaining kidney having supervened.

Dr. O. S. Lowsley, New York: In connection with the question which Dr. Rytina brought up about stone in these cases, I want to recite a deplorable case of a man in middle life, an athlete, who on numerous occasions had passed stones from his left side. His last crisis began three days before I saw him. He was treated by the usual administration of morphin, etc. When I saw him I gave him a larger dose of morphin and the crisis passed off. He had had terrific pain for three days, and at the time I saw him he also had a fever. The morphin relieved him of his pain, but his fever continued.

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I did not see him again until about three days later. I then had a blood count and a blood culture made. To our amazement we found that his blood was full of a hemolyzing streptococcus. Then I advised cystoscopy and ureteral catheterization, which were not performed until two or three more days. By that time he was in a very serious state. Finally I did catheterize his ureters. From his left side I got practically pure pus. The right side was comparatively clear. We made a phenolsulphonephthalein test and got a fair return from his right side and almost nothing from his left. I left the catheter in for twelve hours, after the method advocated by Dr. Caulk of St. Louis, and his temperature dropped and stayed down for about thirty hours. In the meantime we were watching him in the hope that we had relieved the condition and that he would recover, but early the second morning he had a chill and another rise of temperature and we immediately removed the kidney, which was polycystic and badly infected. The operation was regarded as an emergency operation. The nephrectomy was performed rapidly and without any unusual complication, but the man died of uremia two days later. I mention this in answer to Dr. Rytina's question as to whether stones are frequent in these cases, to show that they do occur.

Dr. Martin Krotoszyner, San Francisco: I had a similar experience to that of Dr. Lowsley, but one which, since the kidney was not taken out, had a more fortunate outcome. A woman of 32 came under observation for severe pyuria which was found to have its origin in the left kidney. Owing to the San Francisco earthquake and fire, which occurred a few days after the first cystoscopic examination in this case, a complete diagnosis was not feasible, and on account of severe untoward symptoms an emergency operation consisting of drainage of the left kidney was performed. The patient's recovery was slow and the surgeon in charge expressed his regret that he had not been able to complete the operation by taking out the kidney, as by these means the patient's condition would have improved much more rapidly. Two years later the patient returned with a tumor of the right kidney which, on exposure, proved to be a typical polycystic kidney, which was operated on by puncture of cysts according to Lund's method. The woman eventually made a good recovery.

Dr. John H. Cunningham, Jr., Boston: About a year ago a necropsy specimen was obtained at the Boston City Hospital of a unilateral polycystic kidney, typical in every respect, the other kidney showing only a typical interstitial nephritis. That specimen is the only one in all the records of the hospital, where there are many necropsies, that shows a unilateral polycystic kidney. I think that all the authentic evidence corroborates what Dr. Barnett says about its rarity.

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Another point is in regard to the operative procedure. I think it is very questionable if, at any time, we are justified in performing a nephrectomy in bilateral polycystic disease. It is difficult by all the tests at our command to estimate at all times exactly what the kidney is doing. We have very accurate means, but there may be, occasionally, some slight unestimable function of the kidney that we cannot by any means know, and which is important in the subject under discussion. For that reason, if for no other, I think a nephrectomy should never be performed in bilateral polycystic kidney, and that every bit of kidney tissue of any value should be saved. We have performed the operation of Rovsing five times, and the results are as gratifying as results may be in such a hopeless condition. These five patients have been temporarily benefited by the operation and have lived over a period of three years. Two of them have lived over a period of five years. The disease is one in which complete health can never be restored, the kidney can never be made entirely healthy and the patient remain in perfect health. It seems to me that the most we may expect is a few additional years of comfort, which condition, in my opinion, is best secured by the so-called puncture operation of Rovsing.

Dr. Herman L. Kretschmer, Chicago: All of the cases of polycystic kidney I have seen have been rather late cases, in which the diagnosis has been rather easy because of the presence of bilateral tumors. I wish to agree entirely with what Dr. Cunningham has said, that one should almost never perform a nephrectomy. I think one can say never, because, as both Dr. Barnett and Dr. Cunningham have pointed out, this condition unquestionably, in the large majority of cases, is bilateral, and while the patient clinically may not have the evidence of polycystic kidney on the side which is to remain, that may develop later and undergo the same degenerative changes. Most of the patients I have seen come in because of the presence of hemorrhage, and they have responded to rest and the usual treatment, and nephrectomy has not been performed. Perhaps in cases in which there is a severe degree of infection one might be justified in draining instead of performing a nephrectomy.

Dr. Charles E. Barnett, Fort Wayne, Ind.: This theory of the misalignment of the secreting and excreting functions is the easiest way out of it from an etiologic standpoint, but it does not look to be entirely true.

I am glad the question of syphilis was brought up. We can unload almost everything on syphilis. There is a possibility of hereditary syphilis and even of hematogenous syphilis producing this deformity, and the polycystic charge can be made. At present we are suffering from syphilophobia. The syphilitic side appeals to me somewhat at this time.

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The stone case is the fourth one reported. I have three others. I think that is a remarkable coincidence, from the standpoint that we first have this interference, desquamation and then stone formation.

Hypernephroma is claimed by some just now to be related to the polycystic changes similar to hypernephroma. I do not see the comparison, but it may be true.

The largeness of the tumor merely implies length of time and accident. I have had cases reported in which the polycystic kidney would almost fill a washtub. It is not a question of size nor a question of tumefaction.

The symptoms mostly found I did not read. The first symptom found generally is hemorrhage. The second symptom is pressure pain, but hemorrhage is generally first.

In regard to the case of streptococcus infection, I wish we could differentiate and prove those questions. We can have a secondary infection. We cannot tell whether it is primary or secondary. Streptococcus cases have not been reported. I shall be glad to add this one. If the mother is full of streptococci, why cannot she carry them into the placenta and into the baby's kidneys, which eliminate the bacterial bodies the same during intra-uterine life as after birth.

The point that I overlooked in my paper about which I wanted to say something is the harm that is done by the injection of any of those irritating silver solutions. They get into the pockets of the pelvis of the kidney and will not come out. A roentgenogram can be made just as well with a leaded catheter as the other way; then if the kidney is polycystic there is no solution retained and thus a great deal of trouble will be avoided. A number of men have reported great trouble from injecting silver solutions into polycystic kidneys.

Dr. Cunningham's case is entirely new. I should like to have a portion of that kidney showing interstitial nephritis, and I should be glad to have other specimens for microscopic examination from cases in which there is a polycystic kidney on one side and a kidney on the other side that looks as if it were not polycystic.

A case was reported in Pittsburgh in which a Rovsing puncture was performed. A month or so afterward the patient was cystoscoped and the ureters catheterized and it was found that the kidney on which the Rovsing operation had been performed was entirely dry, and continued dry. The operation is a time-consuming one, and the little cysts are still there; therefore the kidney will become cystic again. That is one case in which a nephrectomy would have been better than a puncture. When one kidney is entirely out of commission and the other kidney is showing good function, it is better to take out the diseased kidney; but in the majority of cases it is not the thing to do and puncture is the operation of choice.

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CLINICAL CONSIDERATIONS OF VERUMONTANUM DISEASES BASED ON HISTOPATHOLOGY *

A. G. RYTINA, M.D.
BALTIMORE

In 1914, I[1] reported before this section a new urethroscopic method for the radical removal of the verumontanum and discussed briefly the anatomy, histology and pathology of this organ, based on studies of specimens removed by this operation. Since this time, the question has been pursued further, using for the purpose serial sections of the entire verumontanum obtained at necropsies. As a result of this more advanced study, I am able to add somewhat to my previous report and am compelled to make a few minor corrections of views expressed in the former paper concerning its histology. This work has been fuly described.[2] It is my purpose in this communication to consider some clinical phases of verumontanum affections. In order to understand the rationale of some of these clinical considerations, it will be of advantage to borrow briefly from the latter report some features concerning the histology of the colliculus.

ANATOMY.

The verumontanum is a small, rounded, oval, elliptical or conical elevation situated on the floor of the proximal half of the posterior urethra (Fig. 1). On

* From the James Buchanan Brady Urological Institute, Johns Hopkins Hospital.

1. Rytina, A. G.: The Radical Removal of the Verumontanum with Notes on Pathology, The Journal A. M. A., Jan. 2, 1915, p. 45.

2. Rytina, A. G.: The Verumontanum with Special Reference to the Sinus Pocularis, its Anatomy, Histology and Pathology, Jour. Urol., 1, 231.

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its anterior surface in the midline, is an opening which is usually rounded but may be slitlike or quarter-moon in shape and about one-eighth inch in length. This is the mouth of the sinus pocularis or the utriculus prostraticus. Opening at a point in front, below, laterally or even posteriorily to the opening of the sinus pocularis and not necessarily bearing a symmetrical relation, as regards position or shape, are the ejaculatory ducts opening by mouths which may be rounded or slitlike, the latter straight or concave. The verumontanum is not an independent organic entity, but is an elevation formed by the upward growth or extension of the sinus pocularis. In other words. remove from the verumontanum the sinus pocularis and you will have a smooth, flat surface remaining, even with the rest of the posterior urethra and possessing a mucous membrane identical to it.

SINUS POCULARIS

It is obvious from this statement that the chief interest of the verumontanum centers around the sinus pocularis. It is an incapsulated, glandular organ, whose acini open by smaller and larger ducts into one grand or common duct (Figs. 2, 3 and 9). The latter opens on the anterior surface as already indicated. Its glands vary in number, in size and shape in the various specimens. They may be simple racemose glands, or they may, in some portions, show rather marked intra-acinous proliferation (Fig. 2, 4 and 6). The lumina of the glands seem empty, but occasionally, corpora amylacea are seen in them (Fig. 5). Exfoliated epithelium is also seen at times within their lumen. By thin serial sections it is easy to see that these glandular acini open by smaller and larger ducts into one grand or common duct. The latter courses obliquely throughout the entire length of the sinus pocularis and is lined like the smaller ducts with the same epithelium as the acini themselves.

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PHYSIOLOGY

The exact function of the verumontanum is not known. The old view maintained that it was composed of characteristic blood spaces and that during erection the spaces filled and engorged the verumontanum to a size which caused a blockage of the posterior urethra and prevented regurgitation of semen during ejactulation. This view was first promulgated by Weber, and subscribed to by Waldeyer, Frisch, Cobelt, Rüdinger, and by many others even at the present day. To this, there are a number of objections. First of all, the verumontanum is not composed of characteristic blood spaces. Indeed, the blood supply to it is not any richer than that of the surrounding tissue. Further, if this contention were true, the radical removal of the verumontanum would be followed by regurgitation of semen into the bladder during ejactulation. The author has removed the verumontanum without ever noticing this occurrence.

CLINICAL CONSIDERATIONS

After this brief review of the anatomy, histology and physiology of the verumontanum, it is possible to put a scientific interpretation on many of its clinical phenomena, which up to this time has been practically entirely empirical. Some of these theoretical features are correct, but it is interesting to know that they can now receive scientific verification.

INFECTION OF VERUMONTANUM

Naturally, the most important clinical consideration of verumontanum disturbances is that due to infection (Figs. 6 and 7). Its proneness to harbor infection is a most potent factor in the production and the perpetuation of chronic urethral discharges. This is not surprising when we appreciate the important structures composing it, namely, the complicated utricle with its relatively large, round mouth, the openings of

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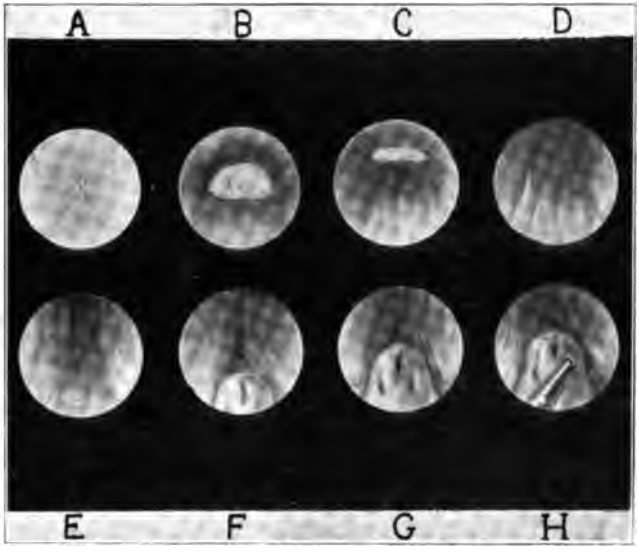

Fig. 1.—Urethroscopic views of posterior urethra from bladder outward: *A*, bladder mucous membrane; *B*, vesical orifice; *C*, vesical orifice; *D*, posterior urethra; *E*, posterior urethra; *F*, posterior urethra and beginning of verumontanum; *G*, verumontanum showing sinus and ejaculatory ducts; *H*, probe in ejaculatory duct.

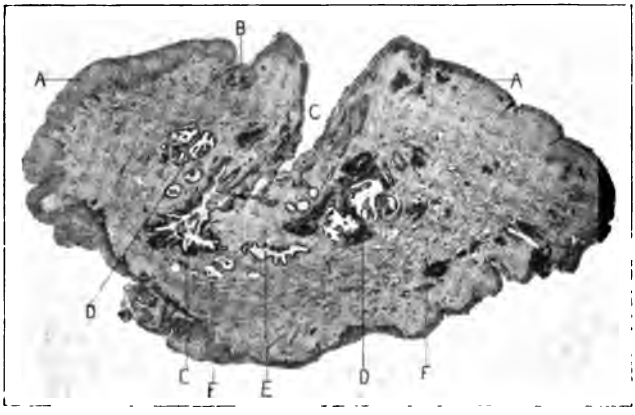

Fig. 2.—Cross section through the center of the verumontanum: *A*, surface mucous membrane; *B*, pit formation; *C*, common duct opening on surface of verumontanum; *D*, gland acini; *E*, tributary duct; *F*, wall or capsule of sinus pocularis.

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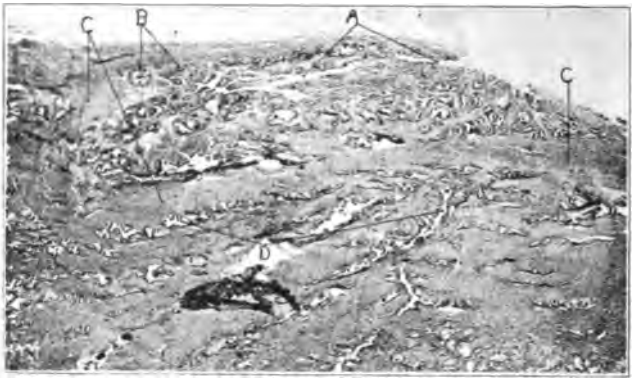

Fig. 3.—Long section through center of sinus pocularis: *A*, common duct opening on surface of verumontanum; *B*, acini, some simple, some showing invagination processes; *C*, wall of sinus pocularis; *D*, ejaculatory duct.

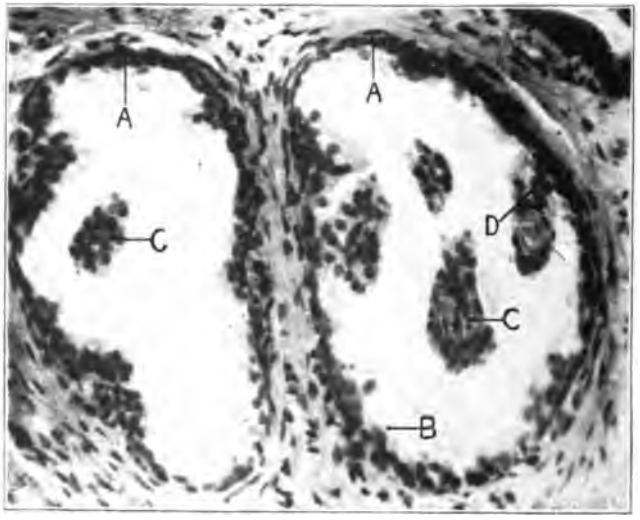

Fig. 4.—Two sinus pocularis acini, showing their finer histology, namely, wall or basement membrane of connective tissue on which are immediately apposed two or three layers of simple cuboidal epithelium: *A*, wall of acini; *B*, cuboidal epithelial cells; *C*, invagination process of epithelial cells broken loose from the wall of the acini; *D*, invagination process not detached from wall.

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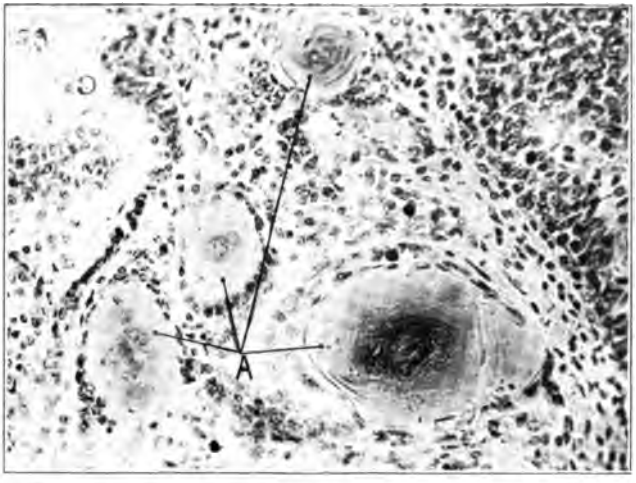

Fig. 5.—Sinus pocularis acini filled with corpora amylacea: *A*, corpora amylacea.

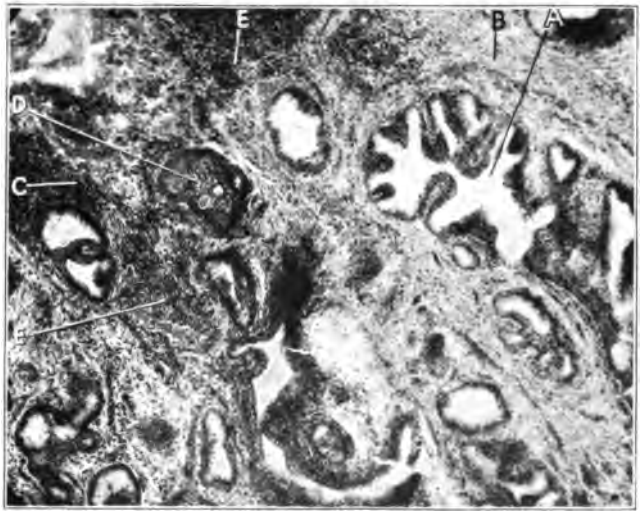

Fig. 6.—Section through an infected varumontanum; infection is limited to left half; right half is normal; *A*, normal acinus showing infoldings, suggests prostatic hypertrophy; *B*, normal stroma; *C*, peri-acinous infiltration with round cells; *D*, normal acinus replaced by round-cell infiltration; *E*, infected stroma.

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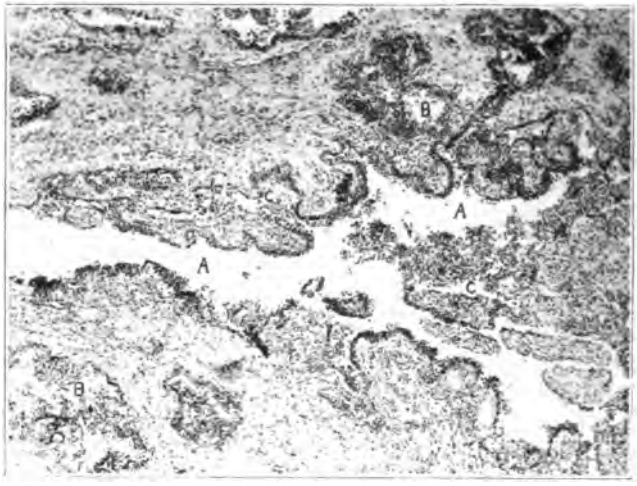

Fig. 7.—Common duct of sinus pocularis; serial study showed infection, traced from mouth of sinus to all the glands below: *A*, common duct; *B*, infected acini; *C*, tributary duct.

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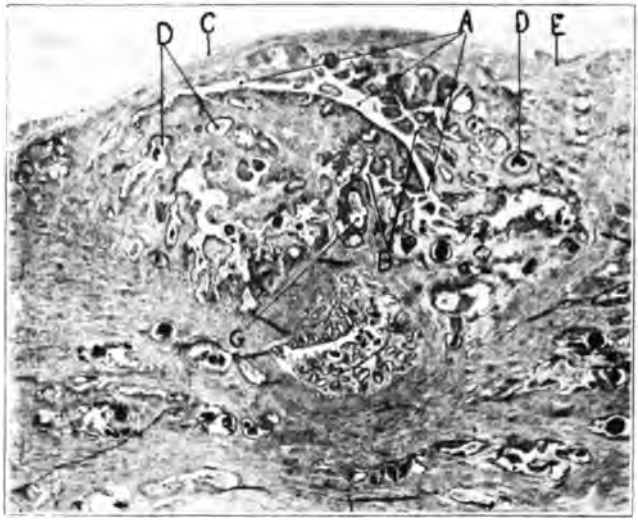

Fig. 8.—Long section through center of verumontanum: *A*, common or grand duct, coursing obliquely through the sinus pocularis, receiving as tributaries the smaller ducts *B;* it terminates a short distance below the surface of the verumontanum *C; B*, smaller ducts emptying into common ducts; *D*, sinus pocularis acini; *E*, the mucous membrane is here present, elsewhere it is detached; *C*, surface of the verumontanum; note what a small amount of tissue remains of the verumontanum proper, if you exclude the sinus pocularis with its contained wall; *F*, wall of sinus pocularis, its continuation from the prostate and its insensible blending with the urethra can be traced; *G*, ejaculatory ducts. Extension of Line *G*, upward erroneous, should have been extended downward to include acini like invaginations below.

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Fig. 9.—Long section showing ejaculatory duct coursing through the prostate and emptying boldly into the sinus pocularis; *A*, ejaculatory duct; *B*, sinus pocularis; *C*, wall of sinus pocularis; *D*, wall of ejaculatory duct; *B*, sinus pocularis; *C*, wall of sinus pocularis; *D*, wall of ejaculatory duct; *E*, prostatic acini; note the similarity between them and the sinus pocularis acini. *F*, sinus pocularis acini; *G*, prostatic ducts; *H*, vesical sphincter muscle. In this section the sinus pocularis did not yet open on the surface.

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the ejaculatory ducts and a few prostatic ducts. The practical significance of this is, that inflammatory changes on the surface of the verumontanum reflect pathologic changes in the structures below, just as an inflammed ureteric mouth suggests renal tuberculosis. To note the frequency of verumontanitis in association with chronic prostatitis and seminal vesiculitis, I examined at random 100 records of verumontanum inflammations occurring in the Brady Urological institute. The results were as follows: verumontanitis in association with chronic prostatitis and chronic seminal vesiculitis, one or both, practically always both, ninety-seven cases; verumontanitis alone, three cases. Of late years much has been said regarding the treatment of verumontanitis by local applications to its surface of strong silver nitrate, the use of the thermocautery, the application of the high frequency current, etc. Mild applications to its surface cannot have any marked effect, whereas strong applications have a destructive cauterant effect which might lead to stricture of the ejaculatory ducts with a resulting sterility, or painful ejaculations, either or both. Why we do not encounter this complication oftener has always been surprising to me. We are now obtaining better results in the treatment of obscure symptoms and persistent discharges by the dilation of the ejaculatory ducts, and the mouth of the sinus pocularis by means of fine blunt pointed probes (Fig. 8). Several cases of painful ejaculation and obscure urethral pain which resisted all treatment for several years were at last benefited by this procedure. Radical excision could also be resorted to, as the removal of the verumontanum does not in any way interfere with sexual intercourse or fecundity. Of great moment, is the knowledge of the almost constant association of chronic prostatitis and chronic seminal vesiculitis with verumontanitis, and the need therefore of attacking these underlying structures at the same time that we are

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treating the colliculus. We are all cognizant of the value of the Kollmann dilator in the treatment of posterior urethral infection. Since the present knowledge of the verumontanum has been obtained, I have made it a practice to open and close the dilator several times at each seance, with the hope that this will cause intermittent compression of the verumontanum and in that way produce a massaging effect on the utricle and the collicular portions of the ejaculatory and prostatic ducts. The instillations by means of special syringes introduced into the mouth of the sinus pocularis as practiced by Geraghty, Luys and others should be tried, but owing to the complicated structure of the utricle it is doubtful if the solutions injected reach any but the superficial portions of the utricle. However, the reaction set up by the silver may result in a beneficial action on the deeper portions of the utricle.

UTRICULAR ABCESS

The next most important pathologic condition in the utricle is suppurative inflammation. Abcess of the utricle is encountered more often than is believed. It produces symptoms of prostato-cystitis and is diagnosed as prostatic abscess or prostatic enlargement. Belfield,[3] as far back as 1894, emphasized this condition. If this possibility is borne in mind when diagnosing prostatic abscesses, a cure may be obtained by a simple urethroscopic procedure and thus save the patient the ordeal of a more serious perineal operation. Further, the latter operation may fail to achieve the desired result. Schmidt[4] believes that a great many so-called prostatic abscesses are utricular abscesses. He claims that the abscesses may reach an enormous size, that the fluctuations can even be felt by the rectum and if, in these cases, we watch the increase of the fluctuating area we will note it is always in the median line, a point of great diagnostic aid.

3. Belfield: The Journal A. M. A., April 21, 1894, p. 574.
4. Schmidt, L. E.: Discussion on paper by Dr. Rytina (Note 1).

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CYSTS OF THE UTRICLE

Cysts of the utricle, like prostatic cysts, are extremely uncommon. Cunningham[5] in 1915 reviewed the literature and was able to gather but six cases of cysts of the utricle, including the one reported by himself. Of these, four were reported by Springer.[6] To these should be added the case of Klotz.[7] Cases reported by Smith[8] and Rolfe[9] as hydrocele of the seminal vesicle and cystic tumor of the left seminal vesicle respectively, were probably instances of distended utricles. The symptomatology of utricular cysts are due to mechanical circumstances, obstructive if they grow urethralward leading to the diagnosis of prostatic hypertrophy. Sexual symptoms might also be occasioned on account of their closeness to organs which are concerned in ejaculations, as in the case reported by Mikhailoff.[10] However, rather large cysts may be present without producing obstructive or sexual symptoms, as in one of Springer's cases. Of the treatments recommended probably the best would be their urethroscopic removal by means of the colliculectotome.[1]

COLLICULAR HYPERTROPHY

It has been stated that the hypertrophy of the verumontanum is always associated with prostatic enlargement. I have examined many specimens of prostatic hypertrophy postmortem and have not been able to confirm this observation. Hypertrophy of the colliculus, however, may take place and to such a size as will completely fill the urethroscopic tube and give rise to obstructive symptoms similar to prostatic enlargement.

5. Cunningham, John H.: Cysts of the Prostate, Surg., Gynec. and Obst., November, 1915, p. 609.
6. Springer: Zur Kenntniss der Cystenbildung aus dem Utriculus Prostaticus, Ztschr. f. Heilk., Prague, 1908, **19**.
7. Klotz, H. G.: Endoscopic Studies, N. Y. Med. Jour., Jan. 26, 1895.
8. Smith, J. R.: Lancet, London, 1872, **2**.
9. Rolfe: Lancet, London, 1876, **2**.
10. Mikhailoff: A Cyst of the Prostatic Vesicle, Med. Rec., New York, 1909, **75**, 101; Ann. d. mal. de org. génito-urin., Paris, 1908, **1**, 197-980.

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POLYPI

Polypi of the verumontanum, while not frequent, are sufficiently common to cause us to be on the alert for their occurrence. They act as foreign bodies and will keep up indefinitely symptoms of chronic discharge, sexual, urinary and referred pains. Only through the urethroscope can they be recognized. Many patients suffering with polypi as well as other verumontanum conditions are treated for years as sexual neurasthenics. The recognition of this fact only will relieve these patients and remove them from the realm of the sexual derelict and the power of the quack. For an able discussion of this phase of the subject, the reader is referred to the article of Randall.[11]

TERATOMAS

There are several cases reported in the literature of persistence of the muellerian ducts resulting in the formation of teratologic abnormalities. These conditions are extremely rare and impossible of relief.

SUMMARY

The verumontanum is not an organic entity but is an elevation formed by the upward extension of the sinus pocularis.

It is not a cavernous structure, indeed the blood supply is not any greater than the surrounding tissue; therefore, its function cannot be of an erectile kind.

As the sinus pocularis is a glandular organ, it is liable to the same affections as other glandular structures, for example, infection, abscess, cyst formation, hypertrophy, polypi, etc.

It is hoped that the better knowledge of its anatomy and histology will lead to a more careful study of its clinical possibilities.

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11. Randall, Alexander: A Study of Benign Polyps of the Male Urethra, Surg., Gynec. and Obst., 1913, 17, 548.

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I wish to thank Dr. Hugh H. Young for placing at my disposal, in carrying out this research the facilities of the Brady Urological Institute; to Dr. Raymond J. Hussy of Bay View, for some of the necropsy material, and Dr. Herman G. Klotz for the loan of Rüdinger's pamphlet.

Professional Building.

ABSTRACT OF DISCUSSION

Dr. C. M. Harpster, Toledo: To my mind the subject simmers itself down to a matter of instrumentation. I do not want to boost any particular instrument, but I wish to say a few words regarding some modifications that I have made of the latest model of the Wossidlo instrument. I think the simpler the instrument we employ the better the results and the easier the treatment will be for the patient. The latest model of the Enrico Wossidlo instrument is a very simple affair; you have an end light with a slit, or a side light alone without the end light. In manipulating the different instruments through the lenses it is sometimes a little bit confusing in the work. So I have had made a very simple lens to place in the end of the instrument, a lens that will give considerable magnification, with a slot in the lens through which we can manipulate our different instruments—cautery, probe, snare, etc. The regulation latest model Wossidlo instrument is a little different from this modification. That is, the lenses slip into the instrument in a different manner, regulated by a screw by which it can be focused.

I am much interested in conditions of the posterior urethra, and I wish personally to endorse all of the remarks of Dr. Rytina. I wish to agree with him thoroughly as to the great number of cases of pathology in the posterior urethra if we hunt for them.

Dr. J. B. Cross, Buffalo: Considering infections of the posterior urethra, it seems to me we ought to bear in mind in the etiology that a very large proportion are secondary to infections in the prostate and seminal vesicles, and, of course, it is not of much use to treat the posterior urethra as long as it is being bathed with pus from the seminal vesicles and prostate. Our experience has been that in at least 80 per cent., after we clear up the prostate and seminal vesicles the posterior urethra will take care of itself.

Dr. O. S. Lowsley, New York: I think I can possibly explain some of the confusion regarding the cavernous tissue that Dr. Rytina mentioned. In the embryo and in boys before puberty the blood vessels in the verumontanum are comparatively very much larger than they are in post puberty cases, and if one has not made a careful study of that condition it is easy to see how a person examining very young prostates, or embryonic prostates, could imagine that there was cav-

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ernous tissue there, on account of the comparatively large size of the blood vessels in the younger specimens. The tributary glands are lined by cuboidal mucosa and ordinarily are not confused with prostatic tubules, which are lined with cylindrical cells, with the gland nuclei at the base of the cell. The glandular development of these tributary glands keeps pace with the very great development in the prostate and the subcervical group of tubules and other structures at the vesical orifice immediately after puberty. I have a specimen from a 17-year-old boy that shows an enormous increase in the size of these glands, which, as I say, keep entire pace with the other structures in that region.

I have found in my series of postmortem cases three cysts of the utricle of moderate size, not very large, but cystic masses, which could easily cause difficulty in the urinary act if a little edema were added to the condition; and there are a number of polypi in my series too. These abnormalities are not infrequent.

Dr. Leo Buerger, New York: I think we are apt to get into error if we attribute too much to the verumontanum. Although I have seen a great many different alterations and a great many of the so-called lesions of the verumontanum through my cysto-urethroscope, I feel today that the rôle that the verumontanum plays in the production of symptoms is small. Of the many lesions that occur in the verumontanum, I believe but few have anything whatever to do with the production of actual symptoms.

As for the various lesions, we find enlargement of the verumontanum, excresences which are the expression of chronic, inflammation, small papillomas, rarely a collection of pus in the utricle, sometimes cystic degeneration of the verumontanum, distortion, scars, and occasionally what some consider to be ulcerations. I have never been able to satisfy myself that ulcerations occur, unless they be tuberculous or are provoked by trauma.

Now which of these lesions are really of importance as regards symptoms? The small papillomas do not, for the most part, cause symptoms. Some patients complain of slight bleeding after intercourse. Take off these papillomas and they still have their bleeding, because in most of the cases the bleeding is due to a stricture or some other cause. Others say that the papilloma is the cause of the neurotic symytoms. I have never been able to come to the conclusion that this is so, although I have noted in a number of instances that nocturnal pollutions and sexual neurosis coexist with papillomas of the verumontanum.

More important are the cystic changes which are the expression of a chronic gonorrheal process. These can be attacked very readily by fulguration or with the punch forceps.

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Abscesses are the most important findings in this region. They can be emptied very readily with scissors forceps, by burning through, or by punching out the superior wall of the utricle with punch forceps through my operating cystoscope. I think those who have used the operating cysto-urethroscope will find it is easier to use than any other, because it offers a larger outlet for the introduction of instruments. If you take my operating cysto-urethroscope, which has a large fenestra and a large catheter outlet, you can readily introduce a small-sized punch forceps of the same type that I use in my operating cystoscope, and not only rapidly remove papillomas of the verumontanum, but also the verumontanum in toto if you wish, with the greatest ease. I find this the most successful method of attacking lesions of the verumontanum. I leave the verumontanum alone except where there is a small papilloma, which I remove for the purpose of exclusion rather than that I think it of any import. I remove the upper surface of the verumontanum if there is pus in it, and if there are cysts I open them. But I believe most of the lesions of the verumontanum are secondary to changes in the vesicles and the prostate. These can be cleared up, and when cleared up the verumontanum will be normal unless the patient falls into the hands of one who continually applies silver nitrate in strong solutions. It is seldom that I apply anything to the posterior urethra; I do not believe it is necessary at all in 99 per cent. of chronic gonorrhea cases. I believe if we clear up the prostate and vesicles the changes in the posterior urethra will disappear.

Another instrument which I think you will find useful is a new universal urethroscope recently devised by me and which combines features of the straight endoscope, the Goldschmidt and Geiringer instruments. Through this it is possible to pass filiform bougies directly into filiform strictures under the control of the eye. It gives a direct view and can be used as an operating cysto-urethroscope, catheterizing cysto-urethroscope, Elsner-Braasch, Kelly, and direct catheterizing cystoscope.

Dr. Theodore Baker, Pittsburgh: I agree fully with Dr. Cross and Dr. Buerger that a great many of the diseased conditions of the verumontanum are undoubtedly secondary to or associated with disease of the vesicles and the prostate gland. It seems to me that in the last few years since there have been so many endoscopes on the market the verumontanum has been terribly abused, especially by the younger men and those whose genito-urinary experience is limited. I believe that a great amount of harm can thus be done. If there is an infection of the prostate and the seminal vesicles, and the verumontanum is butchered, the infection will be aggravated and the patient very likely laid up in bed for awhile. I want to confess that I have been guilty of this sin,

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but hope that I have learned my lesson, and I think that others, especially the beginners in urology, should be made aware of this danger. The prostate and vesicles should be massaged in every case that comes in with chronic urinary symptoms, and if one finds pus in the secretion he cannot say that it is coming only from the sinus pocularis, and not the prostate; and it is in these cases showing pus that one should be very careful about endoscopic treatment of the verumontanum. Of course we all recognize those cases in which the verumontanum is swollen, due to sexual excess, and we know that local applications and rest will cure them. Where there are cysts or vegetations, operative treatment is indicated. I arise to protest only against the indiscriminate use of the urethroscope in those cases in which there is chronic infection of the prostate gland and seminal vesicles.

Dr. R. H. Herbst, Chicago: A number of times in the past I have called attention to the point made by Drs. Cross and Buerger, that in our work when we find a diseased condition of the verumontanum it is usually secondary to an infection of the seminal vesicles and largely due to the pus draining from these organs over the surface of the utricle. To those who believe that the verumontanum is alone responsible for the various symptoms we find in these patients I would suggest the introduction of a curved tube into the posterior urethra, at the same time producing pressure on the seminal vesicles by means of the examining finger in the rectum. By so doing one can frequently observe pus coming from the ejaculatory ducts and bathing over the surface of the utricle. In other words, it is my belief that in most instances the diseased condition of the verumontanum is secondary to infection of the seminal vesicles, and the treatment should be directed to these organs.

Dr. Anton G. Rytina, Baltimore: I can answer the criticisms of Drs. Cross, Buerger and Harpster by saying that when they read the paper they will realize that the points they made are just the ones that I have been trying to emphasize. Just because I have happened to spend a whole lot of time working up the anatomy and histology, which heretofore has been erroneous, I do not see why I should be made the target for the criticism that I think applications to the verumontanum will cure every ill that the urinary tract is heir to. I regret very much that the limited time allowed prevents one from bringing out all the phases of the subject one would like to bring out. Now the point that I am trying to emphasize is that surface changes on the verumontanum reflect pathologic changes in the organs below, the utricle, the prostate and seminal vesicles; I am trying to emphasize the importance of not paying too much attention to treatment of the verumontanum, but more to the prostate and seminal vesicles. I am not cutting off the verumontanum for every

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little thing. I am trying to put the anatomy and histology on a scientific basis. I am sure none of the gentlemen will find any reference to mutilation of the verumontanum.

When it comes to Dr. Buerger making the statement that posterior urethral infection can be disregarded, I think that is stretching the point a little too far. When we consider the complicated structure of the posterior urethra, the fact that the prostatic ducts, the ejaculatory ducts and the utricle open in it, how one can expect to obtain results by neglecting this region is a mystery to me. I realize that we must treat the prostate and seminal vesicles and get rid of the underlying infection. We want to avoid strong caustics, because they will cause stricture of the ejaculatory ducts; but when it comes to treating the utricle, with its complicated structure, we must do something more than we have been doing. I think the Kollmann dilator does good by compressing the verumontanum and producing massage thereof. I have been making it a practice at each seance to open up the dilator several times and in that way try to produce a massaging effect on the verumontanum.

I was glad to hear Dr. Lowsley's explanation for the erroneous idea that the verumontanum is composed of cavernous tissue.

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THE INTRAVENOUS PHLORIZIN TEST

MARTIN KROTOSZYNER, M.D.
AND
WILLIAM E. STEVENS, M.D.
SAN FRANCISCO

Phlorizin is a glucosid which was discovered by de Koninck in 1855. It is derived from the root-barks of various fruit trees, which, when brought to boiling in acid mediums, give off a glucose called phlorose, and a glycogen, the so-called phloretin.[1] Phlorizin occurs in minute and slightly pinkish crystals, and is sparingly soluble in cold water, alcohol and ether, but freely soluble in hot water from which solution it crystallizes out on cooling.[2] In 1885, von Mehring[3] found that phlorizin produces glycosuria in man. Ten years later the first statement in regard to the renal origin of phlorizin glycosuria was made by Zuntz,[4] who, after introducing cannulas into the ureters of a dog, exposed one kidney, into the renal artery of which phlorizin was injected, with the result that sugar appeared first and in greater amount from the ureter of the injected kidney. That phlorizin diabetes undoubtedly originates in the kidney was, later on, proved by Pavy, Brodie and Sian's[5] experiment. After removal of all abdominal viscera except the kidneys of a dog, phlorizin was injected, with the result that no increase in the quantity of blood sugar ensued, while the urine contained a large amount of sugar.

1. Kapsammer: Nierendiagnostik und Nierenchirurgie, 1, 87.
2. New and Nonofficial Remedies, The Journal A. M. A., July 3, 1909, p. 33.
3. Von Mehring: Centralbl. f. d. med. Wissensch., 1885.
4. Zuntz: Arch. f. Anat. u. Physiol., 1895.
5. Pavy, Brody and Sian: On the Mechanism of Phlorizin Glycosuria, Jour. Physiol., 1903.

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Less convincing as regards exact proofs were experimental investigations aiming at localization of sugar formation in the kidney. Seelig,[6] after transforming glucose in the kidney into phenylglucosazone, studied onset and extension of sugar formation microscopically, and from the appearance of large numbers of glucosazone needles at and around the collective tubules, he concluded that sugar excretion occurred almost entirely by means of these channels. Nussbaum,[7] who had found that the glomeruli of the frog kidney were exclusively supplied by the renal artery, concluded, from the absence of sugar in the urine after ligation of that vessel, that sugar formation occurred solely in the glomeruli. Nussbaum's findings, though, were refuted by the investigations of Adami[8] and later on by those of Beddard,[9] who discovered anastomoses between the renal artery and vein in the frog kidney, while the observations of Hellin and Spiro[10] on phlorizin sugar excretion in rabbits with experimental nephritis pointed to the epithelial cells as the principal seat of renal sugar formation. Thus the problem of exact localization of renal glycosuria, which would have cleared up many points of apparent incongruity in the application of the phlorizin test, is still awaiting its final solution.

In 1896, G. Klemperer,[11] who was the first to use phlorizin on renal lesions in man, reported absence of glycosuria in chronic nephritis after giving large doses of phlorizin internally. This method of administration was soon afterward branded as inefficacious by Magnus Levy,[12] who pointed out that phlorizin, by these means, reached the kidneys in an already broken form, and who, after hypodermic injection of the drug, observed glycosuria in various forms of pathologic

6. Seelig: Deutsch. med. Wchnschr., 1900.
7. Nussbaum: Arch. f. Anat. u. Physiol., 1906.
8. Adami: Jour. Physiol., 1885, **6**.
9. Beddard: Jour. Physiol., 1902, **28**.
10. Hellin and Spiro: Arch. f. exper. Path. u. Pharmakol., 1897, **38**.
11. Klemperer, G.: Verhandl. d. Ver. f. inn.. Med. zu Berlin, 1896.
12. Levy, Magnus: Verhandl. d. Ver. f. inn. Med. zu Berlin, 1896.

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kidney conditions. In 1899 Achard and Delamare,[13] on the basis of fundamental experimental investigations, stated that reduction or total absence of phlorizin glycosuria was characteristic of kidney diseases complicated by definite loss of renal parenchyma. On these facts Casper and Richter[14] based their application of the test in the form of hypodermic or intramuscular administration of the drug in conjunction with ureteral catheterization. In this way they were able to study the action of the drug separately on either kidney, and to utilize the test as a comparative index of functional renal capacity in unilateral kidney lesions. According to their statement, the phlorizin test measures the quantity of functionating renal parenchyma and, by these means, that of renal capacity, the percentage of excreted sugar corresponding to the amount of functionating parenchyma of the kidney. When these statements failed to be entirely corroborated by personal observations of various authors, and particularly after Israel's[15] demonstration of kidneys that had been found barren of phlorizin glycosuria, though possessing functionating parenchyma, Casper and Richter[14] modified their views, stating that absence of phlorizin glycosuria was significant of an advanced degree of renal incapacity, while its quantity was directly proportional to that of the functionating parenchyma of the kidney.

For the application of the test, the following technic was finally adopted: As soon as both ureters are catheterized, 2 c.c. of a 0.5 per cent. phlorizin solution (0.01 gm. of the drug) are injected hypodermically, one thigh being preferably selected as the site of injection. Only fresh solutions, never more than two weeks old, are used, and thorough dissolving of phlorizin crystals is effected by placing the phlorizin

13. Achard and Delamare: Soc. de Biol., 1899, 21, 1.
14. Casper and Richter: Funktionelle Nierendiagnostik., Berlin-Wien, 1901.
15. Israel: Mitt. a. d. Grenzgeb. d. Med. u. Chir., 1903.

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container in a water bath from which it is removed the moment the boiling point is reached. The phlorizin solution is then drawn directly from its container into the syringe and at once injected. The appearance of sugar, which normally occurs about fifteen to twenty minutes, and not later than thirty minutes after phlorizin injection, is ascertained by means of test tubes containing small amounts of heated Fehling's solution, and urine portions for quantitative sugar determination are collected during the next fifteen to thirty minutes, during which period phlorizin sugar excretion is known to be at its climax. Thus, the whole test can, in most instances, be finished in about an hour.

Inaccurate dosage, resulting from loss of water, or precipitation of crystals on cooling of the phlorizin solution, is obviated by strict adherence to these technical details, which must be carried out under trained supervision. Quantitative sugar determination is afterward done by means of Lohnstein's saccharimeter, for which only 0.5 c.c., or about 8 minims, of urine suffice; in order to insure accuracy of comparative results, three saccharimeters, two for both renal urines and the third for distilled water as control, are employed.

The literature contains either insufficient or no data concerning the technic of phlorizin application, of which we can find only brief mention in Kapsammer's[16] book. Omission of a description of technical details in textbooks and publications on the subject is, according to our experience,[17] probably responsible for the often reported failures in obtaining glycosuria, whereas we in our extensive practical work with the test have had no difficulty in that direction.

The test was soon recognized as one of our most important means for estimating relative kidney func-

16. Kapsammer: Nierendiagnostik und Nierenchirurgie, 1, 92.
17. Krotoszyner: Am. Jour. Dermat., 11, 9.

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tion. Israel,[18] who always maintained a skeptical attitude toward the real value of functional kidney tests, designated the test as a welcome addition to our diagnostic armamentarium, and Albarran[19] concedes to the method real usefulness. Barth[20] considers the test particularly important for the diagnosis of difficult cases, and Kapsammer[21] claims for the phlorizin test first rank among renal functional methods. Greene and Brooks[22] designate the test the most practical of functional methods, a view from which they have not departed in the latest edition of their textbook. Our own results with the test were most gratifying, and careful comparison with the results from other functional tests, especially from phenolsulphonephthalein, brought forth this statement:[23] The phlorizin, phenolsulphonephthalein and urea tests show in normal cases almost identical values for both kidneys, and exhibit in pathologic cases a striking parallelism of diminished functional values. As compared with the phlorizin method, the phenolsulphonephthalein test is subject to fewer technical errors and is less time-consuming, while the possibility of exact quantitative estimation of excreted sugar renders the phlorizin test much more reliable than the phenolsulphonephthalein test.

THE INTRAVENOUS TEST

Thus, the cumbersome technic and the length of time required for its performance appeared to be the most important objectionable features tending toward sidetracking or even eliminating the hypodermic phlorizin test in favor of the more commodious and expeditious phenolsulphonephthalein method. Success in meeting the first drawback depended obviously

18. Israel: Berl. klin. Wchnschr., 1902.
19. Albarran: Exploration des fonctions rénales, Paris, Masson, 1905.
20. Barth: Arch. f. klin. Chir., 1903, 71.
21. Kapsammer: Nierendiagnostik und Nierenchirurgie, 1, 100.
22. Greene and Brooks: Diseases of the Genito-Urinary Organs, Philadelphia and London, 1917, p. 85.
23. W. E. Stevens: The Comparative Value of Modern Functional Kidney Tests, The Journal A. M. A., May 16, 1914, p. 1544.

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on the possibility of bringing the glucosid to the cystoscopic room in a vehicle in which it could be kept indefinitely in solution without, by precipitation of phlorizin crystals, losing its efficacy, and at the same time insuring the uniformity of results which generally attends the employment of phenolsulphonephthalein. For these purposes we experimented, at first, with ampules, similar to the familiar type in use for the phenolsulphonephthalein test, and containing the required amount of phlorizin in a nonprecipitating, 0.25 per cent. solution, as recently suggested by Greene.[24] However, by extensive experimentation, including comparative tests with fresh phlorizin solutions, it was found that ampule efficacy became vitiated in the course of time, four months constituting the limit, after which it was either considerably lessened or entirely extinct. While, therefore, not recommending ampule administration for general use, as involving the risk of inaccuracy, we would, nevertheless, suggest the exclusive use of this most commodious method of phlorizin application for large urologic clinics in which routine renewal of ampules could easily take place every month. For the average urologist, however, we advise the use of tablets, which we finally succeeded in devising, and which were made for us after the following formula: phlorizin, 0.01 gm., and sodium chlorid sufficient to make 0.03 gm.

Phlorizin injection by means of these tablets is a simple and expeditious procedure. The tablet is placed in the barrel of an all-glass Lüer syringe, into which, after adjustment of the needle, 2 c.c. of hot distilled water are drawn up, and injection is made as soon as, by shaking, thorough dissolving of the tablet has been effected.

Elimination of loss of time, which would remove the second obstacle to the general acceptance of the phlorizin test, appeared the more imperative, since

24. Greene: New York Med. Jour., August, 1915.

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intravenous administration of phenolsulphonephthalein had of late become established as a rapid and safe comparative functional method. It was only natural that we attempted to attain this end by the same intravenous route.

It was obviously from the start incumbent on us to establish the safety and innocuousness of this mode of phlorizin administration. In the literature we could find only one reference disclosing untoward results of large intravenous doses, that of Leschke,[25] who observed experimentally in rabbits grave clinical symptoms (spasms, paralysis of heart and respiration). The same author's statement that, after intravenous administration of large doses of phlorizin, an integral part of the drug was traceable in the blood of nephrectomized animals, was refuted by Glaesner and Pick,[26] who, on the basis of their repeated experimental work, insisted that no trace of enormous phlorizin quantities, up to 3.0 gm., could be found in the blood of nephrectomized animals. Neither did Biedl and Kolisch[27] nor Herszky[28] observe symptoms of kidney irritation or disagreeable by-effects and after-effects consecutive to large doses of phlorizin. For clinical purposes Albarran[19] first advocated the use of comparatively large phlorizin doses (0.02 gm.), which, later on, Casper and others[29] recommended for cases in which ordinary doses failed to produce reactive glycosuria.

Since, therefore, small doses, which we administered in the beginning of our work, were productive only of sugar values of such minute quantities as to be practically valueless for purposes of comparative estimation, we did not hesitate to increase the dose cautiously until, by numerous tests on healthy and

25. Leschke: Arch. f. d. ges. Physiol. (Pflüger's), 1910, **132**, 319.
26. Glaesner and Pick: Arch. f. d. ges. Physiol., 1910, **133**, 82; **135**, 176.
27. Biedl and Kolisch: Eighteenth Congress f. inn. Med., Wiesbaden, 1900.
28. Herszky: Med. Blaetter, 1902.
29. Salomon: Berl. klin. Wchnschr., 1909, No. 51.

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diseased individuals, we ascertained the fact to our full satisfaction that intravenous phlorizin administration in doses sufficiently large to insure satisfactory duration and intensity of sugar reaction was absolutely harmless and not attended by untoward sequelae. The dose of 0.01 gm. phlorizin, contained in our tablets, was found to be entirely sufficient for ordinary purposes, and even injection of the double dose, which was repeatedly made in cases in which no glycosuria was obtained after the ordinary dose, was never followed by untoward by-effects and after-effects.

Several hundred normal and pathologic cases were tested in this way in order to obtain reliable data on average time of appearance, acme of excretion, and disappearance of intravenous phlorizin glycosuria.

After laborious compilation of our cases we finally decided to utilize for tabulation case groups of equal numbers and representing, wherever feasible, different observations of the same type. By these means we were able to obtain particularly gratifying results for purposes of group comparison.

BLADDER TEST

The bladder test for determination of total renal permeability by means of intravenous phlorizin injection is performed in the following manner: The bladder is emptied by introduction of a catheter which is left in situ, and 1 cg. of phlorizin is injected into one of the arm veins. Testing for sugar is begun at once by letting a few drops of urine flow into test tubes containing a few cubic centimeters of heated Fehling's solution, until typical sugar reaction occurs. The average results of the test under normal and pathologic conditions may be gleaned from Tables 1 and 2.

In cases with normal renal permeability sugar appeared in about seven minutes and in cases with pathologic or reduced renal capacity not earlier than

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fifteen minutes. In both types of cases, sugar excretion was at its acme during the first fifteen minute period, was markedly reduced during the second, and was very low or had disappeared during the third period.

Our extensive work with the bladder test, which we intend to continue in the future, disclosed in many instances such inconclusive and even contradictory results as to be useless for tabulation. Many problems concerning significance of delayed appearance or entire absence of glycosuria, and relation of percentage to absolute quantity of sugar excretion, are still waiting for their solution. More conclusive evidence is particularly needed with regard to phlorizin as compared with phenolsulphonephthalein estimation. We therefore wish to limit the discussion at this time to a few facts which in the course of our investigations appeared to be fairly well settled.

In normal cases, sugar reaction generally ceased forty-five minutes after its appearance. In pathologic cases, sugar was traceable for considerably longer periods, extending to more or less than an hour, and in a few instances even to two hours. Delayed appearance, which never exceeded seventy-five minutes, did not seem to run parallel to length of sugar reaction. In a few pathologic cases the acme of excretion occurred at a later period than in the normal. In quite a number of cases of arteriosclerosis, contracted kidney, and cancer of the prostate, no sugar reaction occurred, and in only a few of them could delayed and faint sugar reaction be obtained on injection of the double dose of phlorizin. In a few of these cases, in which absence of phlorizin glycosuria persisted, initially poor values of cryoscopy and blood urea gradually approached more normal points coincident with improvement of clinical symptoms. Simultaneous phenolsulphonephthalein tests performed in this type of cases always showed delayed appearance and low,

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TABLE 1.—RESULTS OF BLADDER TEST BY MEANS OF INTRAVENOUS INJECTIONS OF 2 C.C. OF 0.5 PER CENT. PHLORIZIN IN NORMAL CASES

Number	Sex*	Age	Diagnosis	Appearance Minutes	Fifteen-Minute Periods			Remarks
					First	Second	Third	
1	♂	26	Chronic prostatitis	12.5	0.72	0.36	0.04	
2	♂	52	Pelvic osteosarcoma	9	0.54	0.15	0.0	Qualitative determination with Fehling's solution
3	♀	63	Carcinoma vesicae	6.5	0.9	0.4	0.0	
4	♂	28	Bilateral inguinal hernia	8	1.11	1.7	0.31	
5	♂	40	Sexual neurasthenia	6	0.7	0.28	0.21	
6	♂	33	Sec. syphilis	10	0.6	0.2	0.0	Quantitative determination with Lohnstein's saccharimeter
7	♂	32	Sexual neurasthenia	6	1.4	0.4	0.0	
8	♂	27	Sexual neurasthenia	4.5	2.2	1.6	0.25	
9	♂	42	Chronic prostatitis	6	0.64	2.8	0.2	
10	♀	24	Chronic pelvic gonorrhea	8	3.75	2.66	0.62	
Average				7.65	1.25	1.05	0.16	

* In this column ♂ denotes male and ♀ female.

TABLE 2.—RESULTS OF BLADDER TEST BY MEANS OF INTRAVENOUS INJECTIONS OF 2 C.C. OF 0.5 PER CENT. PHLORIZIN IN PATHOLOGIC CASES

Number	Sex	Age	Diagnosis	Appearance Minutes	Fifteen-Minute Periods			Remarks
					First	Second	Third	
1	♂	62	Prostatic hypertrophy	26	0.3	0.06	0.05	
2	♂	77	Rightsided calculous pyonephrosis	7.5	1.6	0.6	0.0	No reduction with Fehling's after 90 minutes
3	♂	35	Rightsided renal tuberculosis	25	0.1	1.6	0.3	
4	♂	69	Prostatic hypertrophy; complete retention	11	1.6	0.3	0.14	No reduction after 2 hours
5	♂	73	Prostatic hypertrophy; chronic myocarditis	8.5	1.7 1.6	0.94 0.01	0.4 0.0	Reduction ceased after 90 minutes Reduction ceased after 90 minutes
6	♂	68	Carcinoma of prostate	10				
7	♂	76	Carcinoma of prostate	30	0.1	0.1	0.0	Reduction ceased after 40 minutes
8	♂	70	Carcinoma of prostate	20	0.7	0.3	0.0	
9	♂	60	Prostatic hypertrophy; chronic nephritis	15	0.3	0.0	0.0	No reduction after 55 minutes
10	♂	68	Cancer of bladder; leftsided pyelonephritis	11	0.1	0.0	0.0	No reduction after 60 minutes
Average				16.4	0.81	0.391	0.089	

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but definitely determinable, phenolsulphonephthalein values. While, on repeated testing, phlorizin sugar appearance and quantity showed such a bizarre and irregular curve as to be void of prognostic significance, phenolsulphonephthalein appearance and output, on the other hand, in the same cases assumed the characteristic curve of rising values coincident with improvement of clinical symptoms.

Equally unsatisfactory at our hands was the result of the numerously performed estimations of the total amount of phlorizin glycosuria and of the comparative determination of percentage and absolute quantity of excreted sugar, and, like Casper,[30] we do not attach to these procedures any practical value. We also agree with Blum and Prigl,[31] in refusing to accept unreservedly Kapsammer's statement that normally prompt appearance of phlorizin glycosuria is an absolute proof of normal renal capacity. But we fully endorse Greene's[32] recent statement that delayed appearance of phlorizin sugar rarely occurs in healthy individuals, and we consider persistently delayed onset of phlorizin glycosuria indicative of impairment of renal function.

In a few cases of hematuria in old prostatitics in whom the phenolsulphonephthalein test was impracticable, prompt phlorizin sugar appearance furnished a most welcome prognostic aid for operative indications. In a large number of this type of cases, on the other hand, persistent absence of glycosuria rendered the test useless.

To sum up, in the bladder test the time method of sugar appearance is of value, while quantitative methods are useless. The bladder phlorizin test is not a successful rival to the well-defined, quantitative bladder phenolsulphonephthalein test.

30. Casper: Handbuch d. Cystoskopie, 1911, p. 328.
31. Blum and Prigl: Wien. klin. Wchnschr., 21, 22.
32. Greene: Hospital Bull. of the Dept. of Publ. Char. of New York, January, 1917.

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THE RENAL TEST

The technic of the intravenous phlorizin test for determination of comparative renal permeability is identical with that of the bladder test. As soon as bilateral ureteral catheterization is performed, phlorizin is injected and the appearance of sugar is noted on both sides. It was found that intravenous phlorizin glycosuria, when urine is collected directly from the kidneys, appeared normally about five minutes after injection. Quantitative comparative sugar determinations are then made by means of Lohnstein's saccharimeters in the previously described manner.

Tables 3 and 4 show graphically the average acme, decrease and disappearance of sugar excretion in the comparative test.

Average figures for normal cases show a striking parallelism of comparative appearance and percentage in all three tests, with differences so insignificant as to be negligible.

In the group of pathologic cases, the average of phlorizin appearance was considerably delayed on both sides, while figures for sugar percentage on both sides were somewhat smaller than those found in normal cases. Phenolsulphonephthalein, on the other hand, appeared in pathologic cases about equally as early as in normal cases, while the difference of phenolsulphonephthalein quantity amounted to almost half of that found in normal cases. The average bilateral urea values were considerably reduced as compared with those of normal cases. Averaging of values on the pathologic against those on the normal side for phlorizin and phenolsulphonephthalein gives a ratio of about 1 : 4, showing also for pathologic cases a fair parallelism of these tests.

Table 7 was prepared in order to ascertain which of the three tests produced the most uniform comparative figures, establishing it, by these means, as the most accurate and thus the most reliable index of relative kidney function.

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TABLE 3.—RESULTS OF RENAL TEST IN NORMAL CASES: COMPARATIVE VALUES OF PHLORIZIN

No.	Sex	Age	Diagnosis	Fifteen-Minute Periods						Remarks
				First		Second		Third		
				R.	L.	R.	L.	R.	L.	
1	♀	28	Chronic urethritis and trigonitis..	1.06	1.22	0.2	0.3	0.00	0.00	No reduction with Fehling's after 37 min.
2	♂	40	Chronic prostatitis.....	4.0	3.0	3.6	1.2	0.2	0.0	No reduction after 35 minutes
3	♀	42	Functional polyuria.....	0.2	0.2	0.0	0.0	0.0	0.0	No reduction after 35 minutes
4	♀	30	Chronic prostatitis.....	2.0	2.0	1.0	1.0	0.12	0.12	Trace figured as 0.1
5	♂	45	Chronic prostatitis.....	1.52	1.68	Trace	Trace	0.0	0.0	
6	♀	35	Chronic pelvic peritonitis.....	1.56	1.4	Trace	0.5	0.0	0.0	
7	♂	30	Sexual neurasthenia.....	1.36	1.38	0.64	0.98	0.0	0.15	No reduction after 75 minutes
8	♂	38	Chronic prostatitis.....	4.8	4.0	0.2	0.2	0.01	0.01	
9	♂	35	Chronic prostatitis.....	1.25	1.0	0.25	0.2	0.0	0.0	
10	♂	40	Balanoposthitis.....	1.7	2.0	1.24	1.56	0.92	1.14	No reduction after 70 minutes
Average.....				1.95	1.79	0.73	0.6	0.12	0.14	

TABLE 4.—RESULTS OF RENAL TEST IN PATHOLOGIC CASES: COMPARATIVE VALUES OF PHLORIZIN

No.	Sex	Age	Diagnosis	Fifteen-Minute Periods						Remarks
				First		Second		Third		
				R.	L.	R.	L.	R.	L.	
1	♂	56	Bilateral nephrolithiasis.....	0.18	0.12	0.0	0.0	0.0	0.0	No reduction with Fehling's after 37 min.
2	♂	30	Rightsided hydronephrosis.....	0.9	1.1	0.5	0.3	0.01	0.0	No reduction after 40 minutes
3	♀	28	Bilateral hydronephrosis.....	0.8	0.56	0.02	0.03	0.18	0.01	No reduction after 45 minutes
4	♀	43	Bilateral pyelonephritis.....	0.66	0.52	0.2	0.04	0.0	0.0	No reduction after 78 minutes
5	♂	46	Rightsided hydronephrosis.....	0.35	1.9	Trace	Trace	0.0	0.0	Trace counted as 0.01
6	♂	30	Rightsided calculous pyonephrosis	0.3	1.7	0.0	1.15	0.0	0.88	
7	♀	36	Rightsided pyohydronephrosis....	0.1	0.8	0.0	0.6	0.0	0.5	
8	♀	46	Bilateral hydronephrosis.....	0.59	0.56	0.3	0.2	0.35	0.28	Microscopically: Many pus cells on right side; only a few pus cells on left side
9	♂	32	Rightsided pyelonephritis.....	0.42	0.62	0.28	0.35	0.1	0.2	
10	♂	26	Leftsided nephritis.....	0.52	0.48	0.2	0.06	0.1	0.05	
Average.....				0.48	0.83	0.15	0.27	0.07	0.19	

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TABLE 5.—COMPARATIVE RESULTS OF PHLORIZIN, PHENOLSULPHONEPHTHALEIN AND UREA IN NORMAL CASES

No.	Sex	Age	Diagnosis	Phlorizin				Phenolsulphonephthalein				Urea		Remarks
				Appearance		Amount %		Appearance		Amount %				
				R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	
1	♀	32	Urinary frequency; trigonitis	6	6	1.48	1.48	10	7	4	3	0.009	0.011	Quantitative phenolsulphonephthalein determinations made with Hellige colorimeter Comparative urea determination made with Doremus ureometer
2	♂	28	Chronic prostatitis	7	6.5	1.56	1.36	2.5	2.5	13	14	0.015	0.016	
3	♀	35	Urinary frequency; trigonitis	6.5	6.5	1	1	4	4	25	15	0.001	0.001	
4	♀	40	Cystitis; vaginal catarrh	5	5	0.4	0.4	3	3	4	4	0.003	0.003	
5	♀	24	Chronic pelvic gonorrhea	4	4	0.3	0.3	3	3	12	15	0.001	0.001	
6	♂	38	Chronic prostatitis	5	5	0.5	0.54	5	5	12	5.5	0.015	0.014	
7	♂	29	Sexual neurasthenia	9	9	1.56	1.66	6	7	11.5	11.0	0.0026	0.0032	
8	♀	34	Caruncle at meatus	5.5	6	0.5	0.36	3	3	10	8	0.0052	0.0056	
9	♂	36	Chronic prostatitis	5	5.5	0.72	0.52	4	4	4	6	0.016	0.015	
10	♀	26	Urinary frequency; chronic urethritis	5	4.5	0.6	0.4	4	4	18	25	0.007	0.012	
Average				5.8	5.8	0.86	0.8	4.45	4.25	11.35	10.65	0.075	0.08	

TABLE 6.—COMPARATIVE RESULTS OF PHLORIZIN, PHENOL SULPHONEPHTHALEIN AND UREA IN PATHOLOGIC CASES

No.	Sex	Age	Diagnosis	Phlorizin				Phenolsulphonephthalein				Urea		Remarks
				Appearance		Amount %		Appearance		Amount %				
				R.	L.	R.	L.	R.	L.	R.	L.	R.	L.	
1	♂	30	Rightsided renal neoplasm	7	6	0.08	Trace	4	3.5	Trace	Trace	0.004	0.0012	Trace of phlorizin, figured as 0.01; trace of phenolsulphonephthalein, figured as 0.01; trace of urea, figured as 0.001
2	♀	28	Bilateral pyelonephritis	6.5	6	0.8	0.56	6	7	2	9.5	0.002	0.004	
3	♂	27	Rightsided hydronephrosis	8	14	0.3	1.7	7	7.5	4	6	0.001	0.0024	
4	♀	33	Leftsided pyelonephritis	5	5	1.74	0.86	4.5	5	12.5	4	0.028	0.015	
5	♂	46	Rightsided hydronephrosis	14	5	0.6	0.2	5.5	3.5	4.5	5.5	0.012	0.01	
6	♂	27	Leftsided renal tuberculosis	5	4.5	0.58	0.0	7	7	2.6	0.04	0.02	0.009	
7	♀	30	Leftsided pyonephrosis	5	20	1.0	Trace	3.5	25	18	Trace	0.02	Trace	
8	♂	34	Rightsided renal tuberculosis	7	8.5	0.37	2.4	4	4.5	Trace	17	0.013	0.022	
9	♂	56	Bilateral nephrolithiasis	13.5	6.0	0.18	0.12	4.5	4	3	6	0.006	0.008	
10	♀	35	Rightsided pyonephrosis	10.5	8	1.3	3.5	3	3	7.5	8	0.005	0.012	
Average				8.1	8.3	0.69	0.98	4.9	4.7	5.4	5.6	0.011	0.0117	

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In normal as well as in pathologic cases, sugar excretion was at its acme during the first fifteen minute period, was markedly reduced during the second period, and was very low or had entirely disappeared during the third period. Sugar reaction in renal urines had, as a rule, disappeared after forty-five minutes in normal and pathologic cases, and persisted to an hour or longer (seventy-eight minutes in one instance) in only a few observations of the latter type. Since the acme of intravenous phlorizin glycosuria is reached almost immediately after its appearance, and since, for comparative quantitative sugar determination with Lohnstein's saccharimeters, very small urine quantities (less than 1 c.c.) suffice, the time required for the performance of the test is, under favorable conditions, shorter than in any other functional method based on injection of a foreign substance.

For the purpose of comparing the intravenous phlorizin with other well established functional tests, the two most popular methods for comparative estimation of renal function, the phenolsulphonephthalein and urea tests, were chosen. The results of these investigations appear in Tables 5 and 6.

The ratio for comparative values of urea, phlorizin and phenolsulphonephthalein in normal cases was 104 : 107 : 187. Thus urea, an end-product of metabolism, naturally excreted by the kidneys, showed almost equal values on both sides (100 : 104), phlorizin, a foreign substance injected for measuring renal function, running a close second (100 : 107), while phenolsulphonephthalein, a dye used in the same fashion as phlorizin, showed marked discrepancy of parallelism (100 : 187).

The most important reason for this phenomenon is, without doubt, the unequal amount of urine which both kidneys under normal conditions may, and as every experienced cystoscopist knows, actually do secrete during the same period of time. Leaking of

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TABLE 7.—RESULTS OF RENAL TEST IN NORMAL CASES: COMPARISON OF PARALLEL VALUES ON BOTH SIDES FOR PHLORIZIN, PHENOLSULPHONEPHTHALEIN AND UREA

No.	Sex	Age	Diagnosis	Phlorizin		Phenol-sulphone-phthalein		Urea		Phlorizin Values Compared	Phenol-sulphone-phthalein Values Compared	Urea Values Compared	Remarks
				R.	L.	R.	L.	R.	L.				
1	♀	30	Urethral caruncle	0.4	0.47	4	4	0.008	0.008	1.0 : 1.2	1.0 : 1.4	1.0 : 1.0	
2	♀	24	Chronic pelvic peritonitis	0.3	0.3	12	15	0.001	0.001	1.0 : 1.0	1.0 : 1.25	1.0 : 1.0	
3	♂	27	Chronic prostatitis	1.24	0.9	12	Trace	0.014	0.014	1.0 : 1.5	1.2 : 1.0	1.0 : 1.0	Trace of phenolsulphonephthalein counted as 0.1
4	♂	26	Sexual neurasthenia	0.5	0.54	12	5.5	0.015	0.014	1.0 : 1.01	2.2 : 1.0	1.07: 1.0	
5	♂	32	Chronic prostatitis	2.0	2.0	12	12	0.016	0.017	1.0 : 1.0	1.0 : 1.0	1.0 : 1.06	
6	♀	30	Enteroptosis	1.16	1.4	None	3	0.007	0.009	1.5 : 1.2	1.0 : 3.0	1.0 : 1.3	
7	♂	33	Chronic prostatitis	1.3	1.2	15	15	0.016	0.015	1.1 : 1.0	1.0 : 1.0	1.07: 1.0	
8	♂	46	Sexual neurasthenia	0.4	0.35	18	18	0.001	0.001	1.1 : 1.0	1.0 : 1.0	1.0 : 1.0	
9	♀	35	Urethritis and trigonitis	0.34	0.34	17	14	0.056	0.06	1.0 : 1.0	1.2 : 1.0	1.0 : 1.07	
10	♀	40	Urethral caruncle and hemorrhoids	1.48	1.48	4	3	0.0095	0.011	1.0 : 1.0	1.33: 1.0	1.0 : 1.16	
Average				1.02	1.091	2.27	1.22	1.014	1.059				

TABLE 8.—COMPARATIVE PHLORIZIN AND PHENOLSULPHONEPHTHALEIN WITH REFERENCE TO QUANTITY OF RENAL URINES IN NORMAL CASES

No.	Sex	Age	Diagnosis	Phlorizin			Phenolsulphonephthalein					Quantity of Renal Urines Compared	Remarks
				Per Cent.		Values Compared	Quantity		Per Cent.		Values Compared		
				R.	L.		R.	L.	R.	L.			
1	♀	48	Urethral caruncle	3.4	2.5	1.0 : 0.7	40	20	12	6	2.0 : 1.0	2.0 : 1.0	Ureter catheters of equal caliber were employed
2	♀	40	Vaginal catarrh; trigonitis	1.0	1.0	1.0 : 1.0	20	10	25	15	1.7 : 1.0	2.0 : 1.0	
3	♂	29	Chronic prostatitis	4.0	3.0	1.3 : 1.0	7	3.5	9	5	1.8 : 1.0	2.0 : 1.0	
4	♀	36	Chronic urethritis and trigonitis	0.34	0.34	1.0 : 1.0	28	20	17	14	1.2 : 1.0	1.4 : 1.0	
5	♀	42	Vaginal catarrh; trigonitis	0.2	0.2	1.0 : 1.0	13	11	7	6	1.2 : 1.0	1.2 : 1.0	Phenolsulphonephthalein tests done after phlorizin
6	♂	35	Phosphaturia	4.5	3.5	1.3 : 1.0	12	12	14	16	1.0 : 1.1	1.0 : 1.0	
7	♂	45	Chronic prostatitis	4.8	4	1.2 : 1.0	7	10	4	6	1.0 : 1.5	1.0 : 1.4	
8	♂	24	Sexual neurasthenia	1.18	1.08	1.1 : 1.0	12	18	2.5	6	1.0 : 2.4	1.0 : 1.5	
9	♂	40	Balanoposthitis	0.92	1.14	1.0 : 1.2	8	7	10.5	9.5	1.1 : 1.0	1.1 : 1.0	
10	♂	46	Sexual neurasthenia	1.65	1.7	1.0 : 1.08	10	9	13	13	1.0 : 1.0	1.1 : 1.0	
Average				2.2	1.8	1.09: 0.99	15.7	12.0	11.4	9.6	1.2 : 1.0	1.33: 1.09	

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urine alongside the ureter catheter, temporary plugging of its lumen by mucus or a blood clot, and the often occurring unilateral reflectory auria or polyuria are additional factors in causing quantitative differences in renal urines, collected during certain time periods, as necessary for quantitative phenolsulphonephthalein determination. For the comparative phlorizin test, on the other hand, only determination of the amount of sugar excretion at a certain period of phlorizin glycosuria is needed, since it is well known that both healthy kidneys excrete simultaneously about the same amount of sugar. Tables 8 and 9 serve to illustrate this point.

In normal cases the average ratio for comparative phlorizin and phenolsulphonephthalein values was 100: 110. and 100: 120, respectively, while the average ratio for quantities of renal urines was 100: 150. In pathologic cases the ratio for comparative phlorizin and phenolsulphonephthalein values was 100: 300 and 100: 170, respectively, this striking incongruity apparently being due to differences in renal urine quantities, the average of which showed a ratio of 100: 270.

The wide discrepancy of the ratio of renal urine quantities between normal and pathologic cases is most decidedly due to the more frequent occurrence of reflectory unilateral polyuria in the pathologic cases, which, according to Albarran, is observed only rarely in persons with healthy kidneys.

In cases of advanced unilateral pyonephrosis (stone, tuberculous, etc.), when occasionally only a few drops can be collected from the diseased side, and in unilateral hematuria, the intravenous phlorizin test always furnished us with the desired information as regards comparative renal function, which not infrequently was either missing or unsatisfactory with other methods. In renal urines we have not observed absence of phlorizin glycosuria, which, as previously mentioned, so often occurred in application of the test on bladder urines.

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TABLE 9.—COMPARATIVE PHLORIZIN AND PHENOLSULPHONEPHTHALEIN WITH REFERENCE TO QUANTITY OF RENAL URINES IN PATHOLOGIC CASES

No.	Sex	Age	Diagnosis	Phlorizin			Phenolsulphonephthalein					Quantity of Renal Urines Compared	Remarks
				Per Cent.		Values Compared	Quantity		Per Cent.		Values Compared		
				R.	L.		R.	L.	R.	L.			
1	♀	28	Bilateral pyelonephritis	0.8	0.56	1 : 0.7	1.5	6.5	2	9	1 : 4.5	1.0 : 4.3	
2	♂	30	Rightsided renal tuberculosis	0.37	2.4	1 : 6.5	10	30	Trace	17	0.1 : 1.7	1.0 : 3.0	Trace of phenolsulphonephthalein counted as 0.1
3	♂	27	Rightsided hydronephrosis	0.3	1.7	1 : 5.5	14	8	4	6	1 : 1.5	1.75: 1.0	
4	♂	30	Rightsided renal neoplasm	0.08	1.47	1 : 5	3.5	13	Trace	13	0.1 : 1.3	1.0 : 3.7	
5	♂	56	Bilateral nephrolithiasis	0.18	0.12	1.5 : 1	16	7.5	3.5	8	1 : 2	2.1 : 1.0	
6	♀	33	Rightsided pyonephrosis	1.3	2.5	1 : 3	16	3.5	7.5	8	1 : 1	4.7 : 1.0	
7	♂	46	Rightsided hydronephrosis	0.35	1.9	1 : 5	14	7	14	6	2.3 : 1	2.0 : 1.0	
8	♂	30	Rightsided pyelonephritis	0.9	1.1	1 : 1.2	6	2	12	4	3.0 : 1	3.0 : 1.0	
9	♂	25	Rightsided ureter stone	1.2	0.88	1.5 : 1	26	39	10	14	1 : 1.5	1.0 : 1.5	
10	♂	30	Rightsided hydronephrosis	0.36	2.0	1 : 5.5	3.5	10	Trace	9	0.1 : 9	1.0 : 2.9	
Average				0.58	1.56	1.1 : 3.4	11.0	12.6	5.4	9.4	1.6 : 5.1	1.8 : 2.0	

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The ideal aim of functional renal diagnosis tends toward determination of the absolute and largest amount of work which each kidney is able to perform. Since this ideal is not practically available at present, we must be content with methods that, like the phlorizin test, are able to demonstrate the comparative working capacity of each kidney. We hope that the improvement of the test by intravenous administration will serve to secure for it its well earned place among recognized functional methods for determination of comparative renal function. Functional kidney diagnosis is still in its infancy, and can be advanced only by critical consideration of the relative value of the various functional methods, and only in this way will survival of the fittest for practical purposes eventually result.

CONCLUSIONS

1. The intravenous phlorizin test, with our simplified technic, is a commodious and expeditious procedure.

2. In normal cases, sugar appears within seven minutes in bladder urine, and within five minutes in renal urines. The acme of sugar excretion sets in within a few minutes, and its disappearance occurs within forty-five minutes after phlorizin injection.

3. As a test for total renal permeability (bladder test) its usefulness is limited. The prompt appearance of sugar generally indicates normal function, and persistently delayed appearance is characteristic of impaired renal function. Quantitative determination of total sugar excretion is useless.

4. As a test for comparative renal function, the intravenous phlorizin test gives more accurate, and thus more reliable, results, while its technic is as simple and less time consuming than that of the phenolsulphonephthalein test.

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COMPARATIVE RESULTS OF VARIOUS FUNCTIONAL KIDNEY TESTS

BASED ON A SERIES OF CASES *

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So long as the chief cause of death following operations on the genito-urinary tract continues to be uremia, just so long will the concern of the up-to-date conscientious surgeon be the determination of the functional efficiency of the kidneys. Disregard for this important matter too often furnishes the mark of distinction between the skilled urologist and the general surgeon, and explains the relatively high mortality rate for urologic operations in the experience of the general surgeon. Investigation recently[1] revealed the alarming statistics that in twenty-six hospitals in this and neighboring states the mortality for nephrectomy and prostatectomy at the hands of general surgeons was 25.9 and 22.5 per cent., respectively, as contrasted with 7.7 and 4.33 per cent. in seven times the number of operations by eight of the world's most noted urologists. In other words, this means that in a large minority of such operations from 75 to 80 per cent. of deaths are avoidable.

Unfortunately, the urologic world has been almost submerged by a plethora of functional kidney tests — good, bad and indifferent. These are divisible into

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1. Thomas, B. A.: The Significance of Specialism in Surgery with Reference Especially to Genito-Urinary Surgery, Pennsylvania Med. Jour., 1916, **20**, 101.

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those of elimination and those of retention, and comprise the forty-five given in Table 1, in the order of their appearance.

It is conceded that the most accurate method of determining the kidney function is a quantitative metabolic study. At the same time it is fully realized that in the vast majority of instances such a procedure is not only impracticable, but not infrequently fallible. Thus the profession has turned to, employed,

TABLE 1.—FUNCTIONAL KIDNEY TESTS

TESTS OF ELIMINATION	TESTS OF RETENTION
Total quantity of urine.	Total urinary solids
Odor after asparagus (1820)	Normal urinary salts (alkaline chlorids, phosphates and sulphates, and alkaline earths) (excretion)
Odor after turpentine (1820)	Urine urea (excretion) (1872)
Opium (1857)	Total nitrogen (1883)
Mercury (1865)	Cryoscopy (blood, urine) hemorenal index (1898)
Iodid of ethyl (1867)	Electrical conductivity (blood, urine) hemorenal index (1900-1904)
Potassium iodid (1867)	Wright's excretory quotient (1904)
Potassium bromid (1867)	Chlorids (blood, urine) hemorenal index (1907)
Indigo (1867)	Urea nitrogen (blood, urine) (1908)
Anilin (1867)	Ambard's constant (ureosecretory index) (1910)
Turmeric (1867)	Urinary toxicity (1910)
Alkaline carbonates (1867)	Acidosis (1910)
Fuchsin (1877)	Blood nonprotein nitrogen (1912)
Quinin sulphate (1877)	Creatinin (1914)
Salicylic acid (1877)	Creatin (1914)
Benzoic (hippuric) acid (1879)	Uric acid (1914)
Methylene blue (1897)	Indican (1914)
Rosanilin (1898)	Phosphates (1916)
Phlorizin (1899)	
Indigocarmin (1903)	
Experimental polyuria (1904)	
Diastase (1908)	
Phenolsulphonephthalein (1910)	
Pepsin (1912)	
Uranin (sodium fluorescein) (1913)	
Lactose (1913)	
Trypanblue (1914)	

and discarded one after another of the long list of functional tests; nor is the disputed question yet settled as to which is the best.

In the past it has been the practice of urologists in various parts of the world to employ one or more tests in their particular groups of cases, drawing conclusions as to which was the best. Synchronously or subsequently in another quarter of the globe another investigator has reported his researches, relying on one or more other tests in an entirely different group of cases, but nevertheless asserting the discovery of the most reliable test, irrespective of the fact that he

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may have had little or no experience with the beloved idol of his professional brother. It may be true that there are several tests equally good. On the other hand, the fact may be that one of the host is truly superior to all the rest, not only as to reliability, but also as to practicability.

It occurred to us that more accurate information relative to the comparative value of the functional tests might be obtained by subjecting each of a group of patients to all of a series of some of the more reliable, and commonly employed, kidney tests. Accordingly, for the past two years, when not inadvisable, we have carried out painstakingly and impartially the following ten functional kidney tests: indigocarmin, phenolsulphonephthalein, the total nonprotein nitrogen of the blood, the urea nitrogen of the blood and urine, the urine urea by the sodium hypobromite method (Doremus-Hinds ureometer), Ambard's ureosecretory constant of the blood and urine, the creatinin of the blood, and the cryoscopy of the blood and urine.

These ten tests have been selected for study from the extensive list, chiefly because several of them are routine methods and are believed to be the most reliable and practical. A number of others, namely, phlorizin, potassium iodid and lactose, experimental polyuria, acidosis and chlorids, might have been included, but would probably not have proved more meritorious than those utilized, and would merely have imposed an additional inexcusable ordeal for the patients. Phlorizin has few adherents today. Whether or not the test is too sensitive, grave fallacies or inconsistencies have arisen in the study of both normal and diseased kidneys, rendering the test undependable in the experience of most investigators. Potassium iodid and lactose in conjunction with salt and water possess mainly a clinical interest, and have been utilized for the differentiation of tubular and glomerular nephritis. This is a matter which interests internists rather than surgeons. Moreover, the method

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lacks universal confirmation. The experimental polyuria test of Albarran has much to recommend it, but is open to the following objections: (1) difficulties with ureteral catheters and accurate collections of the respective urines; (2) unilateral reflex stimulation or inhibition of function, incident to catheterization; (3) the fact that two or three hours is an unjustifiably long time to permit the ureteral catheter to remain in situ; (4) the inability of some patients to drink the required amount of water; (5) occasionally, the failure to produce polyuria by increased water intake, and (6) in slight lesions of the kidneys the inability to detect differences between the two sides. Acidosis and the phosphate and chlorid content of the blood are estimations promissory of much value in nephritis, but as yet possess only clinical and research importance.

TECHNIC EMPLOYED IN TESTS

Indigocarmin.—In the cases furnishing the text of this report, in order to parallel the method of employment of phenolsulphonephthalein, indigocarmin was administered intramuscularly,[2] although for years in many cases we have injected the dye intravenously and now prefer this method for chromo-ureteroscopy in the unilateral determination of kidney function. The quantitative determinations were made for three hourly intervals, the Duboscq[3] or a recently improvised less expensive colorimeter (Fig. 1) being utilized. Due consideration was accorded the onset of elimination and the quantitative output, although greatest reliance was placed on the index of elimination,[4] that is, the ratio of output for the first and third hours,

2. Thomas, B. A.: Ueber die Chromoureteroskopie in der funktionellen Nierendiagnostik, Ztschr. f. Urol., 1911, 5, 259; The Value of Chromo-Ureteroscopy in Functional Kidney Diagnosis, Surg., Gynec. and Obst., April, 1911; The Results of Two Hundred Chromo-Ureteroscopies Employing Indigocarmin as a Functional Kidney Test, The Journal A. M. A., Jan. 18, 1913, pp. 185-188.

3. Thomas, B. A.: The Quantitative Determination of Functional Renal Sufficiency by the Duboscq Colorimeter: Indigo versus Phenolsulphonephthalein, Am. Jour. Med. Sc., September, 1911.

4. Thomas, B. A.: The Rôle of Functional Kidney Tests and Preoperative and Postoperative Treatment in the Reduction of Prostatectomy Mortality, The Journal A. M. A., Nov. 28, 1914, pp. 1909-1915.

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Fig. 1.—Colorimeter for the quantitative determination of indigo-carmin.

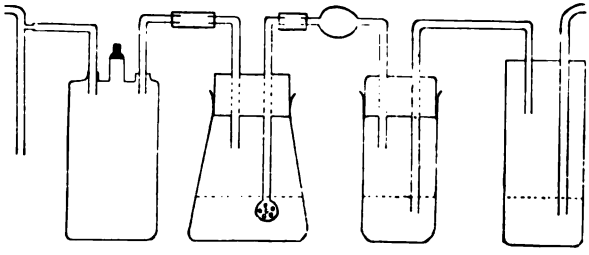

Fig. 2.—Arrangement of apparatus for aeration in nitrogen determination.

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respectively, taking into consideration the onset and alternative interval quantitative output, and hence the stability of kidney function.

Phenolsulphonephthalein.—The application of this test varied from that stipulated by Rowntree and Geraghty[5] in the following respects: The quantitative output was computed for three instead of two hours, and the elimination for the first hour was measured from the time the drug was administered, not from the time it first appeared. It has frequently happened that twenty minutes, a half hour, or even an hour or more, has elapsed following the injection of phenolsulphonephthalein before its appearance in the urine. It has therefore seemed more rational, scientific and accurate to regard the quantitative output for the first hour from the time the drug was administered; otherwise the quantity commonly regarded as eliminated for the first hour comprises that for the hour after elimination begins, plus the time required for it to appear. The latter is a wide variable in renal disease, and, we believe, should not be disregarded.

Determination of Nonprotein Nitrogen of the Blood.—The method employed for the estimation of the nonprotein nitrogen of the blood is in general that followed by Folin and Denis.[6]

Ten c.c. of blood are withdrawn from a vein and placed in a 100 c.c. volumetric flask containing about 5 drops of a 20 per cent. solution of potassium oxalate. The flask is immediately shaken and filled up to the 100 c.c. mark with methyl alcohol—acetone free. The flask is vigorously shaken and allowed to stand, tightly stoppered, for at least two hours. The fluid is then separated from the coagulum by filtering. From 2 to 3 drops of a saturated alcoholic solution of zinc chlorid are now added to the filtrate, and after a few minutes the mixture is again filtered.

Ten c.c. of the alcoholic filtrate, which are the equivalent of 1 c.c. of blood, are pipetted into each of two thin glass test tubes, about 200 mm. in length and 25 mm. in diameter. Four-

5. Rowntree and Geraghty: An Experimental and Clinical Study of the Functional Activity of the Kidneys by Means of Phenolsulphonephthalein, Jour. Pharmacol. and Exper. Therap., 1910, **1**, No. 6.
6. Folin and Denis: Jour. Biol. Chem., 1912, **11**, 527.

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tenths gm. of potassium sulphate, 1 drop of a 10 per cent. copper sulphate solution and 1 c.c. of concentrated sulphuric acid—all reagents to be of highest purity—are added to each tube in the foregoing order. The test tubes are then placed in convenient holders and heated over small microburner gas flames until the mixture becomes completely colorless. As soon as the test tubes have become cool, 8 c.c. of distilled water are added.

Aeration of the ammonia is carried out in the following way:

Into each of two 500 c.c. Erlenmeyer flasks are placed 200 c.c. of distilled water., 10 c.c. of fiftieth-normal sulphuric acid and a few drops of the indicator—Congo red. Each flask is now closed with a two-hole stopper having a Folin tube passing nearly to the bottom of the flask.

The apparatus is now adjusted (Fig. 2) in the following order: Woulfe bottle; Flask C, Test Tube D, containing the digested mixture, and the acid wash bottle. Between Test Tube D and the acid wash bottle, Flask C′ and Test Tube D′ are placed as a control. A sufficient quantity of a saturated solution of sodium hydroxid is added to Test Tubes D and D′ until a bluish color appears.

By means of suction, air is made to pass through the apparatus slowly at first and then rapidly for from twenty to twenty-five minutes. The apparatus is then disconnected and the contents of Flasks C and C′ are titrated against fiftieth-normal sodium hydroxid and the estimation of nonprotein nitrogen is made. One c.c. of fiftieth-normal sulphuric acid is neutralized by 0.00028 gm. of nonprotein nitrogen.

Determination of Urea in Urine.—For rapid determination of the amount of urea in the urine, we have made use of the hypobromite method.

The apparatus, Doremus' ureometer, consists of a graduated fermentation tube mounted on a glass foot and graduated arm with glass stopcock for the introduction of urine.

First, urine should be introduced into the graduated arm and the glass stopcock closed, the opening being full of urine. The graduated fermentation tube should then be rinsed free from all traces of urine and the graduated arm filled with urine to the 0 mark. The graduated fermentation tube should now be filled with hypobromite solution.[7] By means of the glass stopcock, 1 c.c. of urine is permitted to flow

7. The hypobromite is prepared as follows: One hundred gm. of sodium hydroxid are dissolved in 250 c.c. of distilled water. To 20 c.c. of sodium hydroxid solution, in a 50 c.c. graduated cylinder, 2 c.c. of bromid are added; this is shaken and enough distilled water is added to bring the mixture up to the 44 c.c. mark. This makes the hypobromite solution, and as it does not keep well it should be made up fresh each day.

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slowly into the graduated fermentation tube. The urine will rise through the hypobromite, and the urea will instantly decompose, giving off nitrogen gas. The ureometer indicates either the milligrams of urea in 1 c.c. of urine or the grams of urea per fluidounce of urine.

A twenty-four hour specimen should be collected and mixed, and a specimen of this taken for the test if accurate data are to be had.

Determination of Urea Nitrogen of Blood and Urine.—We use the following method:

Three c.c. of blood are introduced into each of two test tubes of dimensions similar to those employed for the nonprotein nitrogen determination. From 2 to 3 drops of 20 per cent. solution of potassium oxalate are added. The mixture is well shaken and 3 c.c. (of a 0.6 per cent. solution) of acid potassium phosphite, one urease tablet,[8] which has been previously pulverized, and about 5 to 10 drops of amylic alcohol, the latter to prevent foaming in the aeration process, and then 5 c.c. of distilled water are added. The same apparatus as employed for the nonprotein nitrogen is used and with the test tubes immersed to the level of the contained mixture, in beakers of water at 50 C., aeration is carried out for from two to three minutes. At the end of this time from 3 to 5 gm. of potassium carbonate are added to each test tube, and aeration is continued for fifteen minutes. In estimating urea nitrogen of the urine, 0.5 c.c. of urine should be used and the same technic employed as described above.

The final estimation is made by titrating the contents of the flask against fiftieth-normal sodium hydroxid, and the computation is made in the same way as for nonprotein nitrogen.

Creatinin of the Blood.—In the estimation of the creatinin of the blood we have used the Duboscq colorimeter and the following application of Folin's method:

To 6 c.c. of blood in a graduated 50 c.c. centrifuge tube, 5 drops of a 20 per cent. solution of potassium oxalate and enough distilled water to bring the mixture up to the 30 c.c. mark are added. The mixture is then stirred until the red blood corpuscles have become laked. Then 1 gm. of picric acid is added and the mixture again stirred at intervals with a glass rod until it becomes a light yellow. The tube is then centrifuged and the supernatant fluid filtered. To 10 c.c. of the filtrate is added 0.5 c.c. of 10 per cent. sodium hydroxid, and

8. The soy bean urease tablets are put up in this convenient form by the Arlington Chemical Company, Yonkers, N. Y. Each tablet contains sufficient enzyme for a single test.

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a similar amount of 10 per cent. sodium hydroxid is added to 10 c.c. of standard creatinin in saturated picric acid. The reading is then made by means of the Duboscq colorimeter exactly at the end of ten minutes after the addition of the sodium hydroxid.

The creatinin standard solution is made up after the method of Benedict:[9] fifteen mg. of creatinin are dissolved in 15 c.c. of tenth-normal hydrochloric acid, and 1 c.c. of the mixture is diluted up to the 100 c.c. mark with saturated picric acid solution. Ten c.c. contain 1.5 mg. of creatinin.

Estimation of the Ambard Quotient.—Ambard's quotient, or the ureosecretory constant, resulted from a series of studies[10] of the laws governing the concentration of urea in urine.

Ambard's First Law: By experimentation Ambard found[11] that if the kidney excreted urine which maintained a constant urea concentration, its urea output during any given time varies as the square of the concentration of urea in the blood of any given person.

C=grams of urea per liter of urine.
Ur=grams of urea per liter of blood.
V=amount of urine excreted in twenty-four hours.
Vxc=urea output in twenty-four hours.

$$\text{Constant} = \frac{Ur}{\sqrt{c}} \text{ provided the urine has a constant concentration.}$$

Ambard's Second Law: By further study[12] Ambard found that variations in the concentration of the urea in the urine altered the relation between the rate of urea excretion and the urea concentration of the blood. After many examinations Ambard concluded (second law) that when a urine of variable concentration is excreted, if the blood urea remains at a constant concentration, the urea output for any given time will be inversely proportional to the square root of the urea concentration in the urine. Twenty-five gm. of urea per liter D_{25} was adopted as the standard concentration of urea in urine. D_{25} equals $\frac{D \times \sqrt{c}}{5}$.

9. Benedict: Jour. Biol. Chem., 1914, **18**, 183.
10. Ambard: Etude sur les concentrations urinaires, Arch. internat. de physiol., 1909, **8**, 437.
11. Ambard: Rapports entre le taux de l'urée dans le sang et l'élimination de l'urée dans l'urine, Comp. rend. Soc. de biol., 1910, **69**, 411.
12. Ambard: Rapports de la quantité et du taux de l'urée dans l'urine, la concentration de l'urée du sang étant constante, Compt. rend. Soc. de biol., 1910, **69**, 506.

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Ambard's third law states that when the urea concentration of the blood and of the urine varies in direct proportion to the square of the urea concentration in the blood and in inverse proportion to the square root of the urea concentration in the urine, the ureosecretory constant $= \frac{Ur}{\frac{D \times \sqrt{c}}{5}}$ or $\frac{Ur}{D}$.

Estimation of Ambard's constant in a case of prostatic hypertrophy[25]:

Amount of urine collected for one hour = 60 c.c.; V = 60 × 24 = 1,440 c.c. — urea per centimeter in urine = 20 per liter. Urea output in urine = 1,440 × 20 per cent. = 28.80 (D).

This amount corrected for concentration of 25 per cent. = $28.80 \times \frac{\sqrt{20}}{5} = 28.80 \times 0.88 = 25.34$ —.

Urea estimation of the blood = 0.514 gm. per liter.

Ambard's constant $= \frac{Ur}{\sqrt{D_{25}}} = \frac{0.514}{\sqrt{25.34}} = \frac{0.514}{5} = 0.1.$

The normal constant has been found to vary between 0.06 and 0.08.

Cryoscopy.—The Beckmann cryoscope, necessitating the preliminary determination each time of the lowering of the freezing-point of distilled water, was employed. The details of cryoscopy need not be given, since in our experience the δ blood and the Δ of the urine have been of all the tests the least reliable. Aside from comparative tests on the urines from each kidney separately, cryoscopy, as a test of kidney efficiency, is of minimal value.

COMPARATIVE RESULTS OF TESTS

In order better to display the comparative results of these various functional kidney tests, they have been tabulated in a number of exemplary cases, normal and pathologic, the latter including mostly retention of urine, due to prostatic or vesical orifice obstruction, or to urethral stricture, with a few nephritics and other renal diseases, mainly surgical.

In Table 2, we enumerate a few absolutely normal ambulatory patients who have been subjected to two or more of the functional tests. The number of cases

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is small, but we believe sufficient to permit judgment as to the results for the functional tests studied. For indigocarmin this was found to be from five to twelve minutes[13] for onset of elimination; from 18.45 to 24.5 per cent. for quantitative output for three hours, with an index of elimination of from 2.9 to 6.7. For phenolsulphonephthalein the respective figures were nine to fourteen minutes, 38.19 to 77.99 per cent. and 1.6 to 16.1. It will be observed that phenolsulphonephthalein was not eliminated as early as indigo, that there was greater variability in quantitative output and extreme variability as to index of elimination, the substance apparently not lending itself well to this method of determination, at least for hourly periods. In this connection the recent animal experimental work of Kendall[14] is of paramount importance. He finds that the phenolsulphonephthalein output is, fundamentally, the ratio between its rate of reduction and the supply of oxygen in the body, and in any given case is dependent on so many factors that its localization effects in any one organ are impossible. If this work is substantial clinically, it will explain many of the singular results heretofore obtained from the employment of this drug as a functional kidney test.

In normal persons the total noncoagulable nitrogen of the blood varied from 25 to 31 mg., and the blood urea nitrogen from 10 to 15 mg. per hundred c.c. The urine urea nitrogen, on the other hand, varied from 58 to 210 mg. per hundred c.c., and in our experience presented nothing of value over the Doremus ureometer method with sodium hypobromite, in which the findings were from 9 to 17 mg. per cubic centimeter. Correspondingly, the ureosecretory index of Ambard showed results of from 0.03 to 0.09. It will be observed that of the retention tests employed,

13. Obtained by voluntary urination every few minutes; it undoubtedly would have appeared earlier if tested by continuous catheterization.

14. Kendall, E. C.: The Fate of Phenolsulphonephthalein when Injected into the Animal Organism, The Journal A. M. A., Feb. 3, 1917, pp. 343-345.

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TABLE 2.—NORMAL KIDNEY CASES

Case No.	Date	Indigo			Phenolsulphonephthalein			Blood		Urine		Ambard's Constant	Creatinin, Mg. per 100 C.c.	Cryoscopy		Remarks
		Onset in Min.	Quant. (3 hrs.) %	Index	Onset in Min.	Quant. (3 hrs.) %	Index	Non-coag. N, Mg. per 100 C.c.	Urea N, Mg. per 100 C.c.	Urea N, Mg. per 100 C.c.	Urea Doremus, Mg. per 1 C.c.			δ	Δ	
1	1911	..	.....	...	10	88.19	1.6	..	..	...	..	....	....	.....	.....	S. W. M.—Normal ambulatory person. Urine: negative
2	1911	10	18.45	6.7	10	70.9	3.9	..	..	...	..	....	....	.....	.....	L. S.—Normal ambulatory person. Urine: negative
3	1911	9	21.36	5.2	9	68.37	16.1	..	..	...	..	....	....	.....	.....	I. G. C.—Normal ambulatory person. Urine: negative
4	1911	5	?	2.9	9	62.08	2.2	..	..	...	..	....	....	.....	.....	B. A. T.—Normal ambulatory person. Urine: negative
5	1911	..	.....	...	10	57.72	5.9	..	..	...	..	....	....	.....	.....	S.—Normal ambulatory person. Urine: negative
6	1912	12	.....	...	..	60.1	4.08	..	..	...	..	....	....	.....	—0.53	McC.—Normal ambulatory person. Urine: negative
7	2/24/16	..	.....	...	9	64.98	11.9	..	..	...	..	....	4.82	.....	.....	Becker.—Diagnosis: epispadias. Urine: negative
	3/ 2/16	..	.....	...	..	.....	...	25	15	210	12	0.02		—0.51	—0.50	
8	1/ 6/17	..	.....	...	14	65.60	...	..	..	...	..	....	....	.....	.....	B. McD.—Diag.: bilat. epididymitis. Blood pressure: systolic 102, diastolic 68. Urine: negative.
	1/ 7/17	10	24.5	4.0												
	1/ 8/17	..	.....	...	..	.....	...	30	15	60	9	0.09	3.2	—0.49	—0.50	
9	5/ 9/17	10	23.31	3.5	..	.....	...	31	10	58	17	0.06	3.2	—0.45	—1.39	Zibinski.—Diag.: spermatocystitis. Urine: negative
	5/10/17	..	.....	...	10	77.99	2.4									

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the noncoagulable nitrogen and the urea nitrogen of the blood showed the greatest uniformity of results and ran a close parallelism. Our results, therefore, do not support the contention of Smith[15] that Ambard's constant or McLean's modification is a more reliable index as to renal involvement and prognosis than is the determination of the blood urea nitrogen alone. It has been maintained by Addis and Watanabe[16] that certain functional tests — as phenolsulphonephthalein — fail to reveal the latent deficiencies in the kidney function, whereas experimental urea may suffice to do this.

We have invariably obtained high figures for creatinin in normal persons, namely, from 3.2 to 4.82 mg. per hundred c.c. of blood. This has been a great disappointment in view of the definite normal and abnormal values and emphatic diagnostic and prognostic claims stipulated by Myers and Lough.[17]

The normal values for cryoscopy have been so variable, namely, from —0.45 to —0.51 degrees for δ and —0.59 to —1.39 degrees for Δ that we have been unable to place much reliance on the results. Therefore, compared with simpler tests, even with respect to the separately catheterized urines of each kidney, in comparison with the molecular concentration of the blood, cryoscopy of the total urine or of the blood alone is, or should be, obsolete. Factors, such as water, diet, polyuria and anemia, materially affect the cryoscopic determinations which, associated with the technical disadvantages, render the method useless.

The pathologic cases subjected to a comparative study of the various functional tests are presented in Tables 3, 4 and 5. Table 3 consists of cases of retention of urine. Of the seventeen cases studied, eleven

15. Smith, R. L. I.: Renal Function in Nephritis, THE JOURNAL A. M. A., Jan. 27, 1917, pp. 278-280.

16. Addis and Watanabe: A Method for the Measurement of the Urea Excreting Function of the Kidneys, Jour. Biol. Chem., 1916, 28, 251.

17. Myers, V. C., and Lough, W. G.: The Creatinin of the Blood in Nephritis: Its Diagnostic Value, Arch. Int. Med., October, 1915, pp. 536-546.

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were due to prostatic hypertrophy, three to prostatitis and seminal vesiculitis, and one each to obstructive contracture of the sphincter vesicae, stricture and carcinoma of the prostate. In all cases operation was successfully performed save in Cases 15 and 16, and organic disease contraindicated surgical intervention in these two cases. The first patient died in a few days of pyelonephritis, and the second case was so complicated by hypertension, myocarditis and dilatation that the patient died a month later. A review of this table reveals the following notable features: The onset of elimination of indigocarmin was noted in from eight to 100 minutes, while phenolsulphonephthalein appeared in the urine in from nine to ninety minutes. In five patients indigo, and in two patients phenolsulphonephthalein, did not appear for an hour or more after injection. Thus we emphasize that this period is not negligible in the quantitative estimation of either of these substances, so far as the first hour's output is concerned, and insist for the best and most reliable data relative to kidney function, that the quantity for the first hour should be timed from the moment of injection rather than from the onset of its elimination. The quantities eliminated for three hours varied from 2.53 to 34.33 per cent. for indigo and from 5.85 to 90.09 per cent. for phenolsulphonephthalein. The indexes of elimination of the two substances suggest a parallelism, but the results have not been so reliable in the case of phenolsulphonephthalein as with indigo. The index of indigo elimination has been extraordinarily trustworthy, and as a guide to kidney efficiency and operability has proved itself *par excellence,* the best at our command. Almost exclusive reliance on the index as an indication of the stability of kidney function in cases of prostatic hypertrophy during the last three years has been rewarded with recovery in every case of prostatectomy. In Case 3, in spite of an indigo index of 0 three weeks before a minor operation, the patient recovered. It will be observed,

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TABLE 8.—CASES OF RETENTION OF URINE

Case No.	Date	Indigo			Phenolsulphonephthalein			Blood		Urine		Ambard's Constant	Creatinin, Mg. per 100 C.c.	Cryoscopy		Remarks
		Onset in Min.	Quant. (3 hrs.) %	Index	Onset in Min.	Quant. (3 hrs.) %	Index	Non-coag. N, Mg. per 100 C.c.	Urea N, Mg. per 100 C.c.	Urea N, Mg per 100 C.c.	Urea Doremus, Mg. per 1 C.c.			δ	Δ	
1	8/ 8/15	20	12.78	1.9	..	.....	....	42	....	....	.....	....	....	—0.52	—1.05	Samuel R.—Diag.: hypertrophy of prostate. B. P.: S. 160, D. 95. Res. urine: 14 oz.; sp. gr., 1.012; heavy trace albumin. Urine: no casts; no sugar. Prostatectomy, recovery
	8/10/15	20	21.83	1.8	..	.....	....	32.2	....	....	.....	....	....	—0.48	—0.81	
2	12/22/15	..	.....	....	..	.....	....	.....	....	....	.....	....	....	—0.51	—0.53	James H.—Diag.: prost. hyper. B. P.: S. 138, D. 78. Urine: sp. gr., 1.020; light cloud of albumin; no casts. Prostatectomy, recovery
	12/23/15	5	24.85	5.1	..	.....	....	81								
	12/24/15	..	.....	....	9	71.66	11.5	.....	10	20	25	0.05				
3	512/22/15	..	.....	....	50	5.85	0	.....	....	....	.....	....	....	—0.54	—0.61	Wm. C.—Diag.: stricture of urethra. Urine: sp. gr., 1.068; no casts. Operation, recovery
	12/23/15	60	4.56	0	..	.....	....	100								
	12/24/15	..	.....	....	..	.....	....	.....	28	162						
	1/17/16	..	.....	....	52	15.42	0	.....	....	....	.....	....	....	—0.50	—0.68	
	1/18/16	..	.....	....	..	.....	....	.....	28	....	.....	0.65				
	1/19/16	80	2.58	0	..	.....	....	106								
	1/27/16	..	.....	....	..	.....	....	58								
	2/ 9/16	..	.....	....	22	37.37	1.04									
	2/10/16	..	.....	....	..	.....	....	75	29	112	.....	....	5.5			
4	3/30/16	..	.....	....	30	66.40	1.5	.....	....	....	.....	....	....	....	....	Morris T.—Diag.: Prostatic hypertrophy. B. P.: S. 170, D. 78. Urine: sp. gr., 1.035; no albumin; no casts. Prostatectomy, recovery
	4/ 1/16	..	.....	....	..	.....	....	59	....	....	.....	....	3.3	—0.48	—0.54	
	4/ 3/16	23	21.75	1.3	..	.....	....	56	23	180	14	0.4				
5	12/28/15	16	26.14	0.4	..	.....	....	.....	....	....	.....	....	....	—0.47	—1.12	William H.—Diag.: prostatic hypertrophy. B. P.: S. 160, D. 148. Urine: sp. gr., 1.016; cloud of albumin; no casts. Prostatectomy, recovery
	12/29/15	..	.....	....	18	87.98	7.8	33								
	12/30/15	..	.....	....	..	.....	....	.....	74	352	11	0.14				
	12/31/15	13	26.20	2.9												
	1/ 3/16	..	.....	....	12	90.09	6.4	47								
	1/ 7/16	..	.....	....	..	.....	....	.....	....	....	10	....	....	—0.49	—0.92	
6	2/ 7/16	..	.....	....	23	52.37	0.8	64	22	360	.....	0.5	4.49	—0.50	—1.18	Solomon C.—Diag.: prostatic hypertrophy. B. P.: S. 150, D. 70. Urine: sp. gr., 1.001; faint trace of albumin; no casts. Prostatectomy, recovery
	2/10/16	20	20.07	1.07	..	.....	....	.....	....	....	19					
	2/17/16	..	.....	....	25	70.16	0.8	56	18	156	.....	0.4	3.63	—0.47	—0.58	
	2/21/16	18	21.56	4.06												
	2/22/16	..	.....	....	..	.....	....	.....	....	....	12					
7	1/31/16	..	.....	....	9	82.59	0.9	61	18	336	.....	0.05	3.0	—0.47	—1.45	Abraham C.—Diag.: prostatitis; epididymitis. B. P.: S. 125, D. 118. Urine: sp. gr., 1.028; heavy cloud albumin; hyaline casts. Epididymotomy, recovery
	2/ 4/16	10	15.96	1.9	..	.....	....	.....	....	....	20					

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8	8/12/16	..	.....	....	55	41.19	0	81	....	....	.....	....	....	—0.47	—0.72	**Wm. B.—Diag.: prostatic hypertrophy. B. P.: S. 130, D. 62. Urine: sp. gr., 1.012; no albumin; no casts. Prostatectomy, recovery**
	8/17/16	85	6.16	0												
	8/18/16	..	.....	....	..	.....	....	.....	30	252						
	8/19/16	..	.....	....	..	.....	....	.....	....	....	.....	....	8.75			
	8/25/16	..	.....	....	45	75.75	0.1									
	8/27/16	40	12.51	0.5	..	.....	....	67	....	....	.....	....	....	—0.47	—0.69	
	8/28/16	..	.....	....	..	.....	....	.....	18	101	.....	....	2.2			
	4/ 6/16	..	.....	....	39	73.94	0.5	60	....	....	.....	....	4.2	—0.44	—0.71	
	4/ 8/16	18	17.38	1.5	..	.....	....	.....	19	98	12	0.08				
9	7/12/16	61	11.58	0	..	.....	....	58	28	190	18	0.5	3.2	—0.52	—0.75	**Edwin K.—Diag.: fibrotic contracture of vesical sphincter. B. P.: S. 170, D. 85. Urine: sp. gr., 1.015; light cloud of albumin; no casts. Prostatectomy, recovery**
	7/13/16	..	.....	....	90	8.40	0									
	7/24/16	16	25.20	1.5	..	.....	....	34	10	44	2	0.05	2.8	—0.47	—0.16	
	7/25/16	..	.....	....	23	59.37	1.8									
10	8/14/16	..	.....	....	24	36.53	....	44	26	36	6.5	0.21	3.2	—0.38	—1.31	Samuel B.—Diag.: prostatic hypertrophy. Urine: sp. gr., 1.015; light cloud albumin; no casts. Prostatectomy, recovery
	8/15/16	33	34.33	2.1												
11	9/18/16	48	25.84	1.4	..	.....	....	.....	....	....	.....	....	....	....	....	Joseph T.—Diag.: carcinoma of prostate. B. P.: S. 140, D. 74. Urine: sp. gr., 1.014; trace of albumin; no casts. Prostatectomy, recovery
	9/20/16	..	.....	....	22	41.61	1.2									
	9/21/16	..	.....	....	..	.....	....	25	11	44	15	0.05	3.1	—0.48	—0.60	
12	9/25/16	11	29.54	1.4	..	.....	....	22	8	50	3.5	0.08	3.2	—0.57	—0.25	Wm. S.—Diag.: prostatic hypertrophy. B. P.: S. 140, D. 85. Urine: sp. gr., 1.016; trace of albumin; no casts. Prostatectomy, recovery
	9/26/16	..	.....	....	19	63.81	0.3									
	10/ 2/16	..	.....	....	39	71.53	0.3									
13	10/18/16	50	16.56	1.0	..	.....	....	56	11	184	30	0.36	3.6	—0.40	—1.40	Robt. P.—Diag.: prostatic hypertrophy. B. P.: S. 130, D. 65. Urine: sp. gr., 1.013; trace of albumin; no casts. Prostatectomy, recovery
	10/19/16	..	.....	....	50	66.87	0.3									
	10/26/16	10	21.4	2.8	..	.....	....	40	8	184	20	0.20	2.8	—0.48	—1.38	
14	10/25/16	22	25.40	1.5	..	.....	....	68	18	117	16	0.04	3.6	—0.46	—1.38	Benj. B.—Diag.: prostatitis; periprostatitis. B. P.: S. 124, D. 61. Urine: sp. gr., 1.014; trace of albumin; no casts. Operation, recovery
	10/26/16	..	.....	....	26	76.85	0.25									
15	11/ 6/16	100	8.80	0	..	.....	....	70	18	100	6	0.11	3.8	—0.46	—0.66	Geo. B.—Diag.: prostatitis; cystitis; pyelonephritis. B. P.: S. 185, D. 105. Urine: sp. gr., 1.020; trace of albumin; no casts. Result: died
	11/ 9/16	..	.....	....	65	19.57	0									
	11/13/16	..	.....	....	40	8.32	0.8									
16	1/17/17	..	.....	....	45	69.12	0.51	44	24	95	2	0.1	3.4	—0.46	—0.36	Geo. L.—Diag.: prostatic hypertrophy; myocarditis. B. P.: S. 240, D. 165. Urine: sp. gr., 1.020; heavy cloud of albumin; hyaline and granular casts. Died Feb. 21, 1917
	1/18/17	55	19.28	1.3												
17	5/30/17	26	14.50	1.2	..	.....	....	.....	....	....	.....	....	....	....	....	Alvin G.—Diag.: prostatic hypertrophy. B. P.: S. 109, D. 76. Urine: sp. gr., 1.014; heavy cloud of albumin; no casts. Prostatectomy, recovery
	6/ 4/17	..	.....	....	35	73.32	0.4	112	17	179	11	0.04	4.3	—0.51	—0.65	

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however, that the index for phenolsulphonephthalein immediately before operation was in the positive phase and the repetition of the indigo test was thought to be unnecessary. Case 15 showed the indexes for both indigo and phenolsulphonephthalein in the negative phase. Operation was not to be considered, and the patient died in a few days. Case 16 illustrates well the fact that the renal function is not the only consideration relative to operability. The patient was the victim of marked myocarditis with dilatation and hypertension, and died a month after his examination.

The total noncoagulable nitrogen varied from 22 to 106 mg. In eleven of the thirteen successful prostatectomies shown in this table, the nonprotein nitrogen exceeded the normal values found in Table 2, and in the cases of the patients who died from a few days to a few weeks after the functional tests were performed, the values for nonprotein nitrogen were no higher than in the cases of several of the patients successfully operated on.

The findings for blood urea nitrogen ranged from 8 to 74 mg. and closely paralleled the results of noncoagulable nitrogen.

The urine urea nitrogen results varied from 20 to 360 mg. per hundred c.c. and permit of no deductions of value; indeed, in comparison with the simple Doremus method, with findings from 2 to 30 mg. per cubic centimeter, the advantage is strongly in favor of the latter, although it is universally admitted that the sodium hypobromite method is susceptible of erroneous results.

It was hoped that Ambard's constant or quotient might furnish a more reliable index of renal efficiency than either the blood or urine urea separately. Unfortunately, this has not been true. In six of thirteen patients successfully operated on, the ureosecretory index was so high that operative intervention might be said to have been contraindicated. We agree,

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therefore with Jonas and Austin[18] and question whether the original formula[19] or McLean's[20] modification is truly the expression of the physiologic law underlying the relation between the urea concentration of the blood and urine and the rate of urea excretion.

Our results with creatinin have varied from 2.2 to 5.5 per hundred c.c. of blood. In a number of the patients successfully operated on the findings were higher than in a few patients who died shortly after the determinations.

The cryoscopic readings varied for the blood from —0.38 to —0.57 degrees; for the urine from —0.16 to —1.45 degrees. The results were such as to stamp this method as worthless so far as the proper treatment of such cases as are shown in Table 3 is concerned.

Table 4 comprises eight cases of nephritis — two of acute parenchymatous, three of chronic parenchymatous, two of chronic interstitial and one of chronic diffuse — studied with respect to the several functional renal tests. It will be noted that in the cases of acute and chronic parenchymatous nephritis, the quantitative output of both indigo and phenolsulphonephthalein was high, and also that almost without exception the indexes of elimination were in the positive phase. Contrasted with this it will be observed that in the chronic interstitial type of the disease, although the quantity eliminated for three hours was variable, the indexes of elimination were constantly in the negative phase. The noncoagulable blood and the urea nitrogen range from 42 to 98 mg. and from 14 to 25 mg., respectively. The urine urea

18. Jonas and Austin: The Value of the Ambard Quotient in the Estimation of Renal Function, Am. Jour. Med. Sc., October, 1916, p. 560.

19. Ambard and Weill: Les lois numériques de la secretion rénale de l'urée et du chlorure de sodium, Jour. de physiol. et de path. gén., 1912, **14**, 753.

20. McLean: The Numerical Laws Governing the Rate of Excretion of Urea and Chlorides in Man, Jour. Exper. Med., 1915, **22**, 212.

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TABLE 4.—CASES OF NEPHRITIS

Case No.	Date	Indigo			Phenolsulphonephthalein			Blood		Urine		Ambard's Constant	Creatinin, Mg. per 100 C.c.	Cryoscopy		Remarks
		Onset in Min.	Quant. (8 hrs.) %	Index	Onset in Min.	Quant. (3 hrs.) %	Index	Non-coag. N, Mg. per 100 C.c.	Urea N, Mg. per 100 C.c.	Urea N, Mg. per 100 C.c.	Urea Doremus, Mg. per 1 C.c.			δ	Δ	
1	3/12/17	..	.....	....	15	60.16	0.6	84	22	78	9	0.15	4.2	0.49	0.48	**Truxton B.—Diag.: acute parenchymatous nephritis**
	3/13/17	15	22.85	2.0												
2	5/24/17	10	14.17	1.1	..	.....	....	.....	....	....	23	....	....	....	....	Michael C.—Diag.: acute parenchymatous nephritis. B. P.: S. 155, D. 110. Urine: sp. gr., 1.014; hyaline, gran. and leukocytic casts; Esbach 1.9 gm. albumin per liter of urine. Duration of illness, five days
	5/26/17	..	.....	....	10	46.2	0.6									
	5/28/17	..	.....	....	..	.....	....	72	15	168	.....	0.57	4.2	—0.47	—1.04	
3	2/14/16	..	.....	....	10	76.20	2.5	58	25	120	.....	0.1	4.5	—0.50	—0.23	Julius B.—Diag.: chronic parenchymatous nephritis; sacroiliac sprain. Result, improved
	2/17/16	11	12.18	2.0												
4	5/21/16	..	.....	....	20	68.32	1.7	.....	....	....	.....	....	....	....	....	James B.—Diag.: chronic parenchymatous nephritis. B. P.: S 180, D. 95. Urine: sp. gr., 1.010; heavy trace albumin; many hyaline and granular casts
	5/22/16	17	22.69	2.6	..	.....	....	78	25	179	12	0.13	4.85	—0.48	—0.65	
5	1/ 8/17	..	.....	....	15	67.07	....	.....	....	....	.....	....	....	....	....	Albert P.—Diag.: chronic parenchymatous nephritis. Urine: sp. gr., 1.020; heavy cloud albumin; hyaline and granular casts
	2/12/17	..	.....	....	10	65.15	....	64	16	448	18	0.15	5.4	—0.46	—1.35	
	2/14/17	10	18.7	1.0												
6	6/ 7/16	..	.....	....	10	64.99	5.1	.....	....	....	.....	....	....	....	....	Wm. J. B.—Diag.: chronic diffuse nephritis. B. P.: S. 175, D. 110. Urine: light cloud albumin; sp. gr., 1.020
	6/14/16	8	16.86	?	..	.....	....	64	18							
	6/21/17	..	.....	....	..	.....	....	.....	....	178	20	0.04	3.21	—0.54	—1.33	
7	4/25/17	..	.....	....	18	68.31	0.6	42	14	196	18	0.08	3.5	—0.49	—0.96	Mrs. P.—Diag.: chronic interstitial nephritis. B. P.: S. 250, D. 120. Urine: sp. gr., 1.010; light cloud albumin; hyaline and granular casts
	4/26/17	15	24.04	0.7												
8	4/30/17	..	.....	....	..	.....	....	98	25	392	16	0.4	5.2	—0.47	—0.75	Wm. R.—Diag.: chronic interstitial nephritis. B. P.: S. 250, D. 120. Urine: sp. gr., 1.010; trace of albumin; no casts
	5/ 1/17	70	8.36	0												
	5/ 2/17	..	.....	....	40	19.74	0.4									

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determinations per hundred c.c. with urease or by the Doremus method were so variable as to be valueless. However, it is significant to note that the Ambard quotient in the cases of parenchymatous nephritis was uniformly high, above the normal, while in the cases of chronic interstitial and diffuse nephritis it was constantly low, below the normal. Apparently, this method may be utilized for the differentiation of parenchymatous and interstitial nephritis, and would seem to be more valuable in this respect than the determination of blood urea nitrogen or total nonprotein nitrogen alone, although as a matter of fact it furnishes no more information than is supplied by the index of elimination of indigocarmin or possibly phenolsulphonephthalein.

The values for creatinin vary from 3.21 to 5.4 mg., and are uniformly high. Improvement has occurred, since the determinations, in the general health of all patients, excepting Patient 4, who died recently.

The results of cryoscopy both of the blood and of the urine present nothing noteworthy, and may be disregarded in a study of nephritides.

In Table 5 we present eighteen pathologic cases, mostly prostatics studied only with indigocarmin and phenolsulphonephthalein, and although the findings demonstrate nothing not already shown in the previous tables, we believe the results to be of sufficient interest to warrant consideration, in view of the popular but unfounded preference for phenolsulphonephthalein as a functional kidney test. It will be observed that the parallelism existing between the results of the two substances is most striking, particularly with respect to the indexes of elimination. Discrepancies exist in only four instances, namely, Cases 3, 8, 11 and 15, and in the last the negative index for indigo was known to be due to improper collection of the hourly specimens of urine. For similar reasons, fallacious indexes for both indigo and phenolsulphonephthalein were obtained in Cases 12 and 17.

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TABLE 5.—PATHOLOGIC CASES — INDIGOCARMIN AND PHENOLSULPHONEPHTHALEIN

Case No.	Date	Indigocarmin			Phenolsulphonephthalein			Remarks
		Onset in Min.	Quant. (3 hrs.) per Cent.	Index	Onset in Min.	Quant. (3 hrs.) per Cent	Index	
1	1911	R. 10 L. 7	..... 10.17	... 2.4	.. 18	..... 21.17	... 3.4	R. C.—Diagnosis: nephrolithiasis. Urine: negative, excepting a few erythrocytes. Calculus 1 cm. in diameter removed from right kidney
2	1911	9½	12.80 (2 hrs.)	...	..	27.27 (2 hrs.)	...	W. E.—Diagnosis: myocarditis. Urine: acid; 1.012; faint trace of albumin; hyaline and light granular casts; cylindroids, mucus. Blood pressure: systolic 185, diastolic 125
3	1911	9	10.52 (2 hrs.)	...	0	0 (2 hrs.)	...	J. S.—Diagnosis: nephritis; tuberculosis, pulmonary (bedridden). Urine: acid; 1.019; cloud of albumin, many hyaline and granular casts; few erythrocytes; mucus. Blood pressure: systolic 125, diastolic 80
4	1911	15	7.81 (2 hrs.)	...	20	16.83 (2 hrs.)	...	C. O.—Diagnosis: prostatic hypertrophy; cardiorenal disease. Urine: acid; 1.015; faint trace of albumin; few hyaline and granular casts; few red blood cells and white blood cells. Blood pressure: systolic 165, diastolic 105
5	1912	..	13.4	1.0	23	23.7	1.06	Scammell.—Diagnosis: prostatic hypertrophy. Residual urine, 8.5 ounces. Prostatectomy, recovery
6	7/ 4/13 7/ 5/13 7/10/17 7/15/13 8/ 7/13 9/ 3/13 9/ 9/13	40 .. .. 50 38 .. 60	8.60 .... 7.40 11.43 ..... 12.58	0.38 ... ... 0.3 0.89 ... 0.4	.. 28 31 25	..... 18.19 12.97 44.5	... 0.15 0.1	Augustus C. V.—Inoperable carcinoma of prostate. Observation extending over three months, until death. The slight improvement about the first of August was due to a cystostomy necessary for drainage. Necropsy revealed, in addition to the carcinoma, bilateral pyoureters and pyelonephritis, secondary to purulent cystitis
7	8/11/13 8/12/13 8/14/13 8/16/13 8/18/13 8/19/13	20 .. .. 10 .. 9	11.43 .... 24.97 ..... 25.78	0.5 ... ... 1.5 ... 2.8	.. 18 .. 19	..... 27.99 34.53 59.4	... 0.5 0.47 1.34	Samuel L.—Diagnosis: prostatic hypertrophy. Prostatectomy, recovery

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8	9/ 9/13	10	10.54	2.3	..	.....	...	Freeman S.—Diagnosis: prostatic hypertrophy; carcinomatous degeneration. Urine: sp. gr., 1.022; cloud of albumin; no casts. Prostatectomy, recovery
	9/16/13	..	.....	...	35	39.33	0.5	
9	9/22/13	..	.....	...	60	63.08	0	David S.—Diagnosis: prostatic hypertrophy. Blood pressure: systolic 198, diastolic 96. Urine: sp. gr., 1.022; trace of albumin; no casts. Prostatectomy, death
	9/26/13	45	18.76	0.3				
10	9/30/13	10	10.54	0.3	..	.....	...	Andrus.—Diagnosis: hypertrophy of prostate. Prostatectomy, death
	10/ 1/13	..	.....	...	60	16.99	0.31	
	10/ 7/13	..	.....	...	88	20.16	0.8	
11	10/14/13	55	15.82	0.39	..	.....	...	Michael T.—Diagnosis: prostatic hypertrophy. Inoperable, largely because of marked cardiovascular lesions
	10/16/13	..	.....	...	30	69.7	0.66	
	10/22/13	..	.....	...	40	79.26	1.06	
	10/23/13	45	24.47	0.64				
	10/30/13	..	.....	...	40	83.36	1.2	
12	11/19/13	..	.....	...	85	66.70	0	Albert M.—Diagnosis: prostatic hypertrophy. Urine: sp. gr., 1.020; light cloud of albumin; no casts. Prostatectomy, recovery
	11/20/13	52	20.20	0.2				
13	1/ 5/14	..	.....	...	20	61.48	0.9	James K.—Diagnosis: hypertrophy of prostate. Prostatectomy, recovery
	2/ 4/14	7	24.65	0.3				
	6/16/14	6	19.13	1.5				
14	4/ 7/14	7	24.4 (2 hrs.)	...	11	35 (2 hrs.)	...	Clinton L.—Cystotomy for vesical calculus two years previous. Stricture of large size
15	6/18/14	..	.....	...	20	64.36	1.1	Mahlon A.—Diagnosis: prostatic hypertrophy; carcinoma of bladder. Urine: sp. gr., 1.020; cloud of albumin; no casts. Prostatectomy, recovery
	6/20/14	7	16.65	0.6				
16	3/25/15	..	.....	...	23	74.1	?	Thomas R.—Diagnosis: senile bronchitis. Urine: sp. gr., 1.020; no albumin; no casts. Recovery
	3/26/15	7	24.07	?				
17	5/ 4/15	..	.....	...	23	49.93	0.4	Archie T.—Carcinoma of prostate. Blood pressure: systolic 113, diastolic 70. Urine: sp. gr., 1.016; no casts; trace of albumin. Prostatectomy, recovery
	5/ 6/15	20	23.06	0.5				
18	9/ 2/15	10	22.24	2.1	..	.....	...	Max F.—Diagnosis: hypertrophy of prostate. Prostatectomy, recovery

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In Case 3, the failure of phenolsulphonephthalein to appear for two hours after injection is inexplicable, unless the recent experimental work of Kendall is substantiated. In Cases 8 and 11 the disagreement between the indexes for indigo and phenolsulphonephthalein on the one hand, and the clinical conditions and subsequent states of the patients, on the other hand, furnishes further support to the belief that phenolsulphonephthalein does not lend itself so well as indigo to this method of determination. Finally, attention is called to Cases 6 and 11 in support of former assertions to the effect that the index of elimination of indigocarmin is a truer gage of renal function of a person than is merely the quantitative output for two hours, particularly if this hourly estimation ignores the period from the time of injection until the substance appears in the urine. In Cases 9 and 10, in which death followed prostatectomy, it is worthy of note that the indexes for both indigo and phenolsulphonephthalein were in the negative phase and contraindicated operation, in spite of the relative satisfactory quantitative outputs for the respective substances.

CONCLUSIONS

1. The analysis of the results of the several functional kidney tests employed in this study emphasizes our belief that of those utilized none possessed virtues superior to indigocarmin, not excepting the tests of retention.

2. Indigocarmin, in our experience, has been more trustworthy and practical than phenolsulphonephthalein.

3. In cases which may require an additional functional test for confirmatory judgment, phenolsulphonephthalein, total nonprotein nitrogen or urea nitrogen of the blood may be utilized.

4. Ambard's quotient was of questionable utility so far as the differentiation of nephritis is concerned,

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and possessed no actual advantage over indigo or phenolsulphonephthalein.

5. Cryoscopy of the whole blood and urine is valueless. If unilateral values are desired, ureteral catheterization is necessary and may be obviated by recourse to more modern and practical tests.

6. Creatinin of the blood and urine urea nitrogen either per hundred c.c. by the urease or by Doremus' sodium hypobromite method demonstrate results so variable as to be unreliable.

7. Irrespective of the finer medical aspects of renal function, the differentiation of glomerular and tubular nephritis, the detection of renal disease in its incipiency, etc., the best functional kidney test today is indigocarmin, at least for the surgeon, because it is not only the most practical test, but it is unsurpassed in reliability, whether employed for unilateral determination by the method of chromo-ureteroscopy or for total function through reliance chiefly on the index of elimination.[21]

116 South Nineteenth Street.

ABSTRACT OF DISCUSSION

ON PAPERS OF DRS. KROTOSZYNER AND STEVENS, AND THOMAS AND BIRDSALL

Dr. Robert H. Greene, New York: Any investigations I have carried on as regards the permeability of the kidney have been from the standpoint of the surgeon, and I have endeavored rather to keep away from the work of the physiologic chemist. I have not felt qualified for it, and I have desired to try to find things which were easy to do, and which would give me some idea as to the condition of my patient in a very short time, and whether or not the work of a physiologic chemist should be brought into any particular case.

Several years ago I tried in the wards at the hospital cryoscopy, methylene blue and phlorizin in connection with ureteral catheterization, and I found that the phlorizin test was the most practical. Later, when phenolsulphonephthalein came to the front, in a comparative series of cases, some of which were medical and some surgical, I tried to find out in a rather rough and ready way which was the most accurate,

21. The remaining article of this symposium, by Drs. Krotoszyner and Stevens, and the discussion will appear next week.

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phenolsulphonephthalein, phlorizin, or the estimation of the nitrogen in the urine compared with the nitrogen in the blood. I also have carried on some little studies on indigocarmin. Indigocarmin, in my experience, is a useful test in connection with ureter catheterization, but it is not as useful in a rough and ready way because it is not elastic enough. The series of cases in which I tried phlorizin, the estimation of the nitrogen in the blood compared with the nitrogen in the urine, and the phenolsulphonephthalein test showed a marked resemblance in the results obtained. The ratio of difference between the three methods was very slight indeed. The most accurate was the estimation of the nitrogen in the blood compared with the nitrogen in the urine; but, of course, this last is work that has to be carried on by a physiologic chemist. The phlorizin test was second and the phenolsulphonephthalein third.

Dr. B. S. Barringer, New York: We all have certain reasons for certain tests. At Bellevue we use three tests, the phlorizin, the percentage urea, and the indigocarmin, for three different reasons. We believe that phlorizin—and that comes first in our estimation—gives a good quantitative estimation, an absolute ratio of what both kidneys are doing. We use the percentage urea test only in comparing the output of the two kidneys, because it gives some sort of a vague index of the relative power of each kidney to concentrate urea. We use the indigocarmin test because it is an easy test to use with the cystoscope, and we can make a diagnosis at times without ureter catheterization, simply by means of the cystoscope in the bladder.

I think when all has been said and done that we cannot depend on the functional tests alone. For instance, if we are going to perform a prostatectomy and we find the phenolsulphonephthalein is low and the blood nitrogen high, we are cautious about operating; but it does not necessarily mean that we do not operate.

Dr. Abraham Hyman, New York: We have employed most of these tests as a routine, and have practically come down to the use of indigocarmin, phenolsulphonephthalein, and the examination of the blood for urea and nitrogen retention. The phenolsulphonephthalein test we do not use in conjunction with ureteral catheterization; a two to three hour bladder specimen is examined so as to obtain an indication of the total output of both kidneys. Indigocarmin combined with ureteral catheterization has been found the most practical, simple and reliable of all the functional tests. Whereas all these tests are of value, and more so if three or four of them are applied, too much stress should not be placed on the results; patients with negative tests should not always be refused operation. During the past few years a few patients with no indigocarmin and phenolsulphonephthalein output, and a number with very slight function, have been success-

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fully operated on for serious renal and prostatic disease. All such operations should be performed under nitrous oxid and oxygen anesthesia. Ether will often turn the balance in the wrong direction.

Dr. William F. Braasch, Rochester, Minn.: It is a difficult matter to place any definite comparative value on the phlorizin, the indigocarmin and the phenolsulphonephthalein tests. As far as phlorizin is concerned, my experience has been with the old method of subcutaneous injection, and I think Rowntree and Geraghty have shown the fallacy of these tests. The method of Dr. Krotoszyner is entirely different. It sounds very promising, and I mean to try it out thoroughly.

There is no doubt that, as a routine procedure, phenolsulphonephthalein is more accurate as an aid to differential diagnosis than indigocarmin. But I believe that indigocarmin, when injected intravenously, has its value. Not infrequently I find it valuable to employ both indigocarmin and phenolsulphonephthalein simultaneously. This would seem impossible because of the difficulty of making colorimeter tests, but the difficulty was obviated by Dr. Anders Peterson, who suggested a method by which the blue color could be removed. He found that by simply adding sodium hydroxid the blue color disappears and the colorimeter test for phenolsulphonephthalein may be continued.

Dr. Anton G. Rytina, Baltimore: I have had very little or no experience with phlorizin, a fair amount of experience with indigocarmin and quite an extensive experience with phenolsulphonephthalein. There is no question whatever that indigocarmin has a place, but for comparative values I feel that it does not compare with phenolsulphonephthalein.

Dr. Herman L. Kretschmer, Chicago: Some years ago when the phenolsulphonephthalein test was first introduced we ran a small series of cases, comparing the phenolsulphonephthalein, the indigocarmin, and the phlorizin tests. At that time we were not estimating the output of indigocarmin; we merely took the time of appearance of the blue dye and the time of appearance of the sugar. Our results were rather uniform as regards time of appearance, all three tests running quite uniform; that is, where there was a delay in time of appearance, the delay was the same for all three tests.

Because of the ease with which one could read the phenolsulphonephthalein figures, we have since then been adhering to the phenolsulphonephthalein in our work.

One of the speakers called attention to the fact that the phenolsulphonephthalein figures occasionally might be very low. I think it was Keyes a few years ago who called attention to the fact that the presence of the ureteral catheters caused a disturbance of the renal function, so that the phenolsulphonephthalein may be low and the function good. In all cases in which the phenolsulphonephthalein figures are very low (I recall one or two instances in which the output

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from the side which was to remain was only 2 per cent.) I make a second test later, getting the whole bladder urine.

Dr. George W. Stark, Syracuse, N. Y.: For about two years I have been using a combined functional test which I believe gives us a better insight as to the reserve power of the kidney than any other test mentioned. It is also a vascular and tubular test—the introduction of water into the circulation together with the phenolsulphonephthalein test. It is not necessarily new.

This test is based on the fact that the viscosity of the blood is absolutely constant, the urine being the varying factor. The normal figures are based on thirty normal cases. The patient is given no water for two hours previous to the test; then a pint of Saratoga Vichy is given. A catheter is left in the bladder and the urine collected for fifteen minutes. The normal case runs 20 c.c.; specific gravity about 1.024. In about half an hour after this extra water is thrown into the circulation all the reserve power of the kidney is brought into play. Under this forced excretion, normally in the third quarter there is excreted about four times the amount that we had in the first quarter. This corresponds to our experimental work on kidneys (that is, one can remove three fourths of the kidney substance and have an animal live). This hypersecretion continues for about an hour and then gradually decreases. Corresponding to this increased secretion is a lowering of the specific gravity to about 1.004 or 1.005. In other words, this shows the ability of the kidney to dilute and concentrate, and is a vascular test. In nephritis, the first quarter is somewhat less, usually under 20 c.c., while in the third quarter there may be increased elimination under forced water drinking, and very little change in the specific gravity, depending on the amount of kidney substance destroyed. Thus, if we get an elimination of 15 c.c. in the first quarter, and an elimination of 30 c.c. with but a slight change in the specific gravity, we assume that about 50 per cent. of the kidney substance is gone.

This test in conjunction with the phenolsulphonephthalein test, I believe, will give a better insight as to the extent of the injury to both the glomeruli and the tubular system of the kidney, and also as to the reserve power of the kidney.

Dr. John T. Geraghty, Baltimore: In our work with functional tests it has been our purpose, not so much to duplicate the tests that give us the same information, but to try to employ tests that give us information that we will not get from any one test. For that reason we test the excretory power of the kidney, which we do best with phenolsulphonephthalein. Indigocarmin and all these substances practically run parallel. It is simply a question of which can be read the best. They are all excreted by the same mechanism of the kidney. But we want to know, besides the excretory capa-

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city of the kidney, any retention which may be present. It is perfectly possible for a kidney to have very markedly decreased excretion and at the same time to be able to excrete the substances that are necessary; so we make a test for retention. We select for this purpose the urea. Urea, creatinin and total nitrogen run practically proportionate. At present we are using urea because the method is simple. The concentrating power of the kidney is another function. So these three tests are all valuable, each different from the others. If there is a markedly increased excretion there will be, as a rule, retention. The concentrating power of the kidney is just as specific a function as the excretion of phenolsulphonephthalein itself, or of urea. It has been known for many years that the concentrating power of the kidney is one of the first things that suffer. There is probably only one disease in which the concentrating power is interfered with and the kidneys normal, and that is diabetes in syphilis.

Dr. Martin Krotoszyner, San Francisco: I cannot agree with Dr. Thomas' sweeping condemnation of cryoscopy, a method which, while it will never become popular among urologists on account of its difficult technic, is nevertheless one of the best tests for the determination of the functional capacity of the kidneys that we possess. On the basis of my constantly growing experience with that method, I venture the statement that in the comparatively few doubtful cases where functional tests are of paramount value, cryoscopy probably gives the most accurate prognostic information of all the tests at our command.

In closing I would once more ask you to try the intravenous phlorizin test on your own patients, as I think it possesses great advantages for comparative determination over other tests. I have not included the indigocarmin test in the tabulated comparative estimations, since that test is not applicable to quantitative determinations and thus is less flexible and less accurate than other tests. For purposes of comparative functional determinations I consider of the retention tests, the urea test, and of the excretion tests, the intravenous phlorizin test, the most commodious and accurate. Particularly in doubtful cases the simultaneous application of the comparative urea, phenolsulphonephthalein, and phlorizin tests is apt in almost every instance to give adequate data on relative kidney function.

Dr. B. A. Thomas, Philadelphia: First answering Dr. Krotoszyner, I did not mean to infer that cryoscopy was absolutely valueless, but I do say, so far as its application to the total urine and blood is concerned, that this is practically true, which is the matter of importance relative to prostatectomy. Doubtless in the experience of a few it may still be serviceable so far as individual urines are concerned, but not of any more value than the information to be obtained

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from the employment of phenolsulphonephthalein or indigocarmin. Unfortunately it affords no more information than the more modern tests and adds difficulty in the technic.

I agree thoroughly with what Dr. Geraghty has said, that what we want to know respecting these various tests is which is simplest, most practical and most reliable. This is the avowed object of the paper. Undoubtedly, with some the results are sufficiently uniform that there need be no particular discrimination. Frequently a second test may and should be utilized to supplement and confirm the findings of the first. Certainly any one will admit that two or more tests are of more value than a single one.

I am just as anxious to adopt the best functional kidney test as any man here, but I have not been shown by my own experience that phenolsulphonephthalein is superior to indigocarmin so far as ease of application, interpretation or reliability of results go. The advantage of indigocarmin is the simplicity of its application. In the past our experience has been largely with the employment of indigocarmin intramuscularly, although recently we have been experimenting considerably with the intravenous use of this substance, using one tenth to one fifth of the intramuscular dose. Employed in this way intramuscular pain, the only objection, comparatively, with phenolsulphonephthalein, is overcome. If merely unilateral kidney function be desired, simple cystoscopy and the observance of the onset of the dye from the respective ureters—chromo-ureteroscopy—suffices to provide the desired information. If quantitative output be desired from the respective sides, obviously the ureters must be catheterized, as in the case of any other functional test, but this requirement with indigocarmin is the exception and not the rule. Herein lies the simplicity and practicability of the indigo test. I have seen cases in which one could not introduce into the ureteral orifices other than the tips of No. 5 catheters. Under such circumstances I defy any cystoscopist to apply the phenolsulphonephthalein test unilaterally. Yet it was a simple matter to determine the functions of the respective kidneys by employing indigo. Thus, in not a few instances, it is impossible to use any test that depends on synchronous bilateral ureteral catheterization.

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